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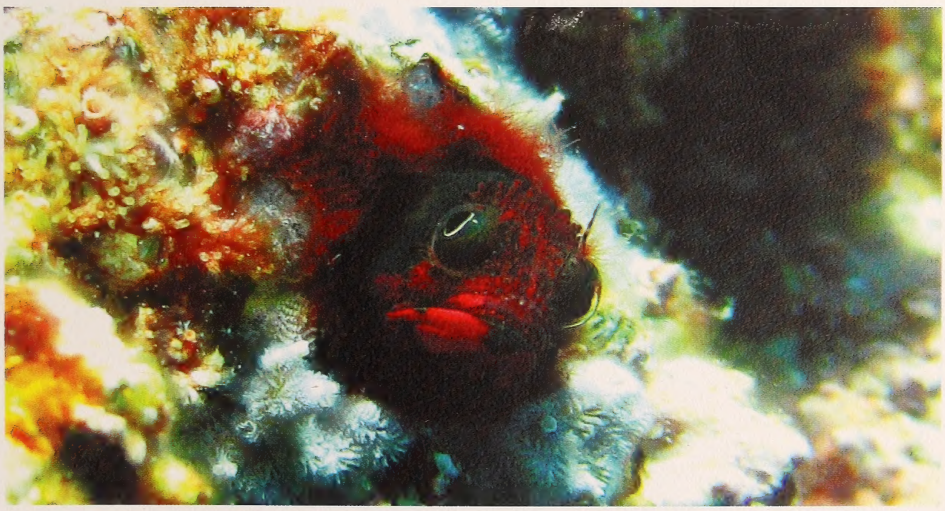

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Cetacean Ecology for Santa Monica Bay and Nearby Areas, California, in the Context of the Newly Established MPAs

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Abstract.—Cetacean occurrence, distribution and behavior were investigated in Santa Monica Bay and nearby areas, California (1997–2007). A total of 425 boat-based surveys documented three species inhabiting the study area year-round - the common bottlenose dolphin, *Tursiops truncatus*, the long-beaked common dolphin, *Delphinus capensis*, and the short-beaked common dolphin, *D. delphis*, and ten species occurring occasionally. Coastal bottlenose dolphins were mostly found traveling, diving and feeding in waters within 0.5km of shore in 81.4% of the sightings (n = 221), but were also observed occasionally in offshore waters. All other species were seen > 0.5 km of shore, often feeding near escarpments and submarine canyons. Endangered species, such as blue whales (*Balaenoptera musculus*) and humpback whales (*Megaptera novaeangliae*), were also recorded in the study area. This paper provides new information as well as an update on data of the composition for the local cetacean community, and offers information that should be considered in the decision-making process associated with the newly established MPAs, and their use. The presence of a diverse cetacean fauna moving in and out the boundaries of these MPAs, also suggests the need for long-term and regular cetacean monitoring in the area.

Introduction

The waters of the Southern California Bight (SCB) support one of the largest and most diverse cetofauna in the world, including 30 cetacean species (Bonnell and Dailey, 1993; Forney et al., 1995; Forney et al., 1999; Schmitt and Bonnell, 2003; Carretta et al., 2006; Soldevilla et al., 2006). Long-term and detailed ecological studies for the SCB have been concentrated mostly on coastal common bottlenose dolphin (hereafter bottlenose dolphin), *Tursiops truncatus* (Defran and Weller, 1999; Defran et al., 1999; Lang, 2002; Bearzi, 2005a,b), whereas only general information is available for other offshore species (Forney et al., 1999; Appler et al., 2004; Barlow and Forney, 2007; Bearzi et al., 2009a).

Within the SCB, Santa Monica Bay and its nearby areas (Fig. 1a) represent a region with unique topographic and oceanographic features (Bonnell and Dailey, 1993), likely to affect the species inhabiting it. A better understanding of the ecology of the local cetacean community is essential to protect these animals, the species they feed upon, and the entire habitats in which they live (Yen et al., 2004; Fury and Harrison, 2008), as well as for making sound conservation and management decisions for Marine Protected Areas (MPAs; Hastie et al., 2003; Wilson et al., 2004).

This study, conducted between 1997–2007 (except for 2003–2004), aims to provide data on occurrence, frequency, distribution and behavior of cetacean species for Santa Monica

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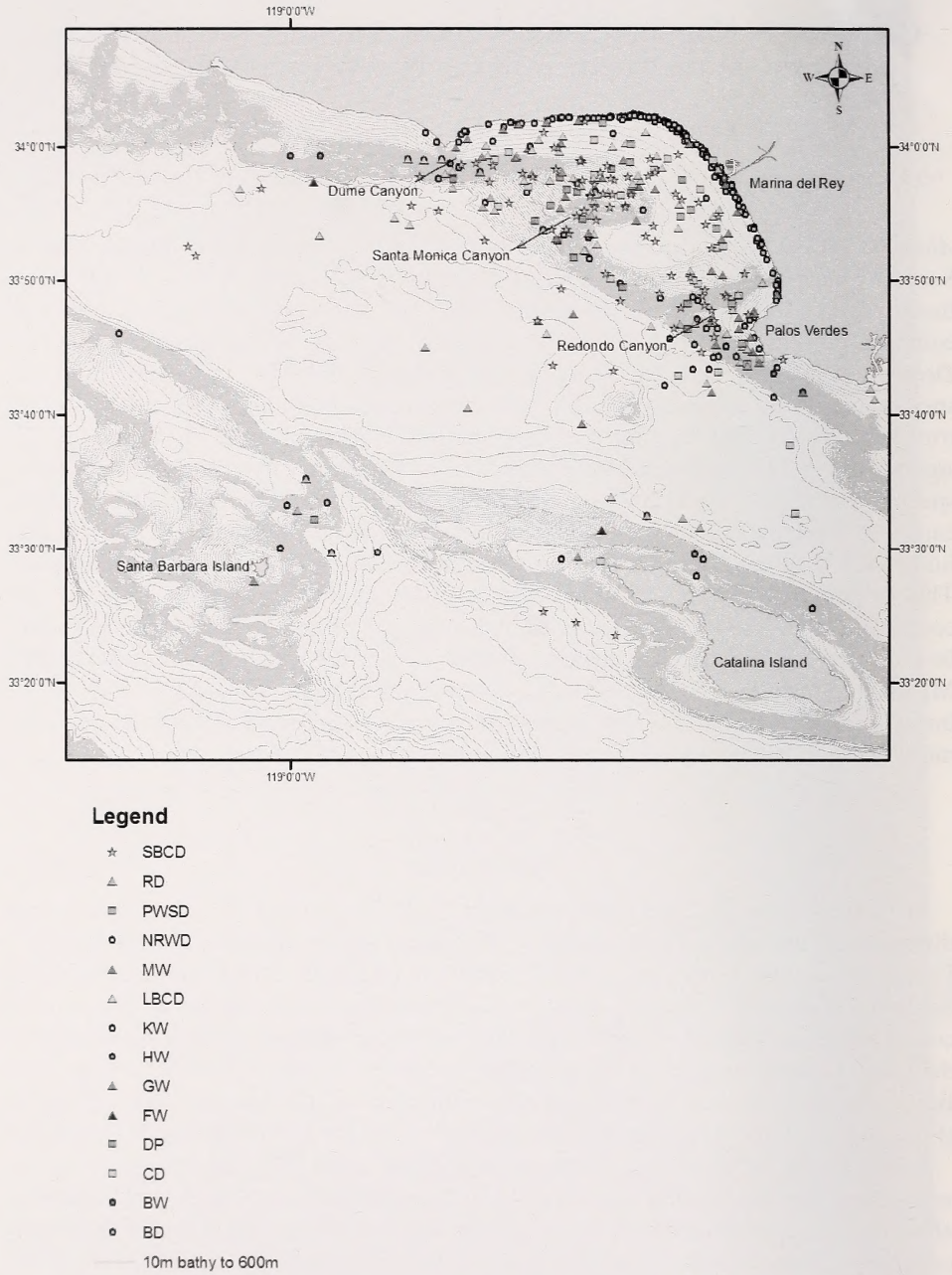


Fig. 1a. The study area and the distribution of cetacean species. Each symbol represents initial GPS coordinates of sightings.

Bay and adjacent areas. Further, considering that: a) several MPAs have recently been approved by the California Fish and Game Commission in the study area (http://www.dfg.ca.gov/mlpa/southcoast.asp), and b) the Monitoring Enterprise is now developing a South Coast MPA Monitoring Plan and it's leading toward the implementation of the

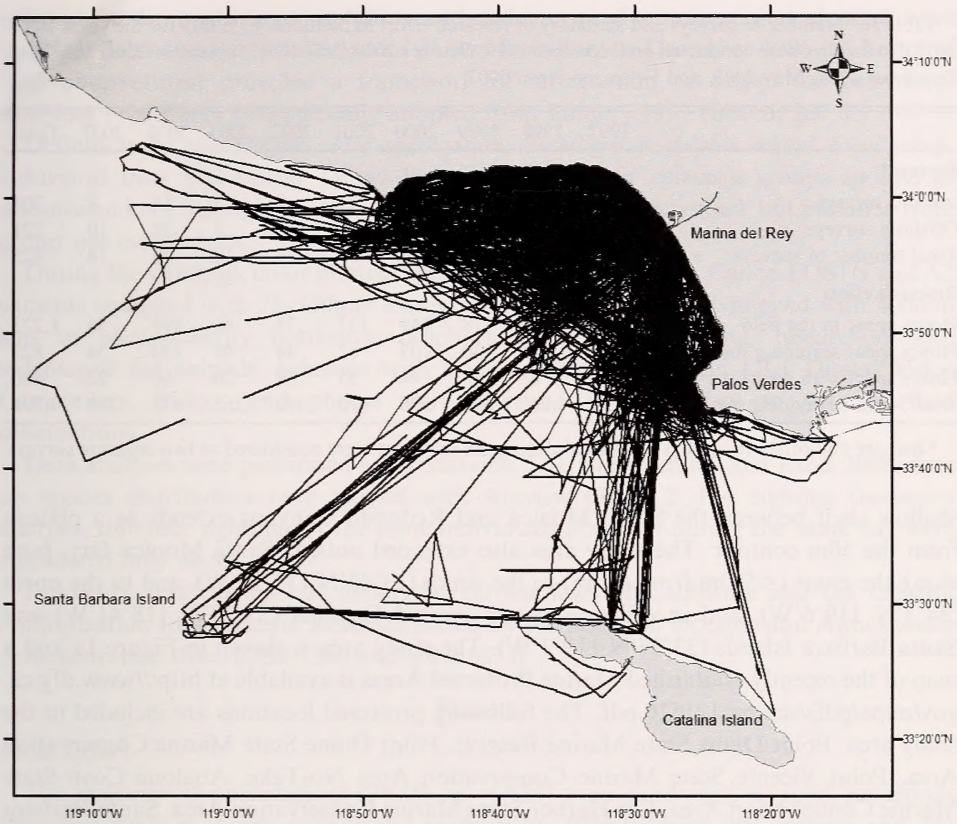


Fig. 1b. The total survey effort in the study area for the years 1997-2007.

South Coast MPA Baseline Program (http://monitoringenterprise.org/where/southcoast.php), the goal of this paper is also to offer information helping to ensure that cetaceans will be properly represented in any decision-making process regarding MPAs. Cetaceans are umbrella species (Mann et al., 2000; Prideaux, 2005) because conservation actions intended at mitigating threats to them can result in protection for entire communities of organisms, as well as the ecosystem itself. Since many cetaceans are now considered key species in conservation planning worldwide, as widely discussed at the last International Committee on Marine Mammal Protected Areas (http://icmmpa.org/) , this work hopes to emphasize to need to include these animals for conservation strategies toward the local MPAs.

Methods

Study Area

The Santa Monica Bay study area (approximately 460 km^2) is a shallow shelf, bounded by the Palos Verdes Peninsula to the south (33°45′N 118°24′W), Point Dume to the north (33°59′N 118°48′W) and the edge of the continental shelf to the west. The bay contains two shallow water submarine canyons (Dume and Redondo) and one deeper canyon, the Santa Monica Canyon. This begins at a depth of about 100 m, at the edge of the escarpment. The bay has a mean depth of about 55m and a maximum depth 450 m. A

Table 1. Number of surveys and summary of research effort in Santa Monica Bay for the years 1997–2007. No surveys were conducted on December 1999, October 2000, July 2001, September 2001, July 2005, December 2005, May 2006, and February–April 2007.

	1997	1998	1999	2000	2001	2002	2005	2006	2007	Total
Surveys*										
Inshore surveys	16	55	39	33	27	9	3	14	8	204
Offshore surveys	34	41	32	31	26	12	7	28	10	221
Total number of surveys	50	96	71	64	53	21	10	42	18	425
Research effort										
Hours spent in the field	144	224	178	149	137	73	68	194	56	1,223
Hours spent searching for cetac.	110	136	130	105	82	44	48	134	34	823
Hours spent with cetaceans	34	88	48	44	55	29	20	60	22	400
N of 5-min behavioral samples	295	1,065	698	525	675	396	265	638	234	4,791

* Inshore and offshore surveys conducted during the same day were considered as two separate surveys.

shallow shelf between the Santa Monica and Redondo Canyons extends as a plateau from the 50m contour. The study area also extended outside Santa Monica Bay, both along the coast (<500m from shore) to the south (33°43′N 118°15′W), and to the north (34°5′N 119°6′W), and in offshore waters around Catalina (33°23′N 118°41′W) and Santa Barbara Islands (33°27′N 119°3′W). The study area is shown in Figure 1a and a map of the recently established Marine Protected Areas is available at http://www.dfg.ca.gov/mlpa/pdfs/scmpas121510.pdf. The following protected locations are included in the study area: Point Dume State Marine Reserve, Point Dume State Marine Conservation Area, Point Vicente State Marine Conservation Area No-Take, Abalone Cove State Marine Conservation Area, Cat Harbor State Marine Conservation Area, Santa Barbara Island State Marine Reserve, Bird Rock State Marine Conservation Area, Blue Cavern State Marine Conservation Area No-Take, Long Point State Marine Reserve, Arrow Point to Lion Head Point State Marine Conservation Area.

Mild temperatures, short rainy winters and long, dry summers characterized the study area. Normal water surface temperatures range from 11 to 22°C. During the 1997–98 El Niño three peaks of sea surface temperature (SST) anomalies were evident: May–June 1997, September–October 1997 and August 1998, with an increase in temperature of + 2°C above the norm (Nezlin et al., 2003).

Data Collection and Analyses

Surveys were conducted from February 1997 to June 2002, and from June 2005 to July 2007 with an average of 5.2 days on the water per month (n = 425, Table 1). We followed routes, planned for even coverage of the entire bay throughout the study period (Fig. 1b). Inshore (distance from shore up to 1km) and offshore (distance from shore > 1km) routes were usually carried out with Beaufort scale 2 or less, sea state 0 and visibility >300m. Surveys were conducted from 7 m (1997–2000) and 10 m powerboats (2001–2002, 2006–2007), and a 17 m sailboat (2005–2006), at an average speed of 18 km h^{-1}. The dolphins' positions and speeds (± 30 m from the boat) were approximated to the boat's position using a GPS.

When cetaceans were spotted, data on the number of animals, size classes and behavior (for definitions see Bearzi, 2005a) and aggregation with other species were recorded on laptop computers at five-minute intervals and throughout the sighting. Boat speed was

reduced in the presence of dolphins and sudden speed or directional changes were avoided. Behavioral data collected *ad libitum* from July to December 1996 (58 hours of field observations) provided a framework of information to design the behavioral sampling procedures systematically adopted from January 1997 (Bearzi, 2003).

Definitions of *aggregation, close aggregation, mixed group, dolphin school, focal group, behavioral state* and *mating* follow Bearzi (2005a); other cetacean groups spotted at distance and not belonging to the observed focal group were recorded, but excluded from group size calculations.

During the sightings, color photographs were taken with 35mm Canon EOS1N and A2 cameras equipped with 75–300mm lenses, and digital Canon 5D equipped with 400mm lens to photo-identify bottlenose dolphins. During the sighting, researchers also videotaped the animals' behavior with Canon Hi8mm or Canon GL1 Digital Video Camcorders. Videos and photos were reviewed in laboratory to validate field observations.

Data analyses were performed using Statview 5.01, Statistica 6.0 and Excel 2008; data on species distribution were plotted with Arcview GIS 9.2. For sighting frequency analysis, different sightings of the same individuals observed during the same day were considered only once.

Fieldwork was carried out under the current laws of California and the General Authorization for Scientific Research issued by the National Oceanic and Atmospheric Administration (files #856-1366 and #8561835).

Results

Field Effort

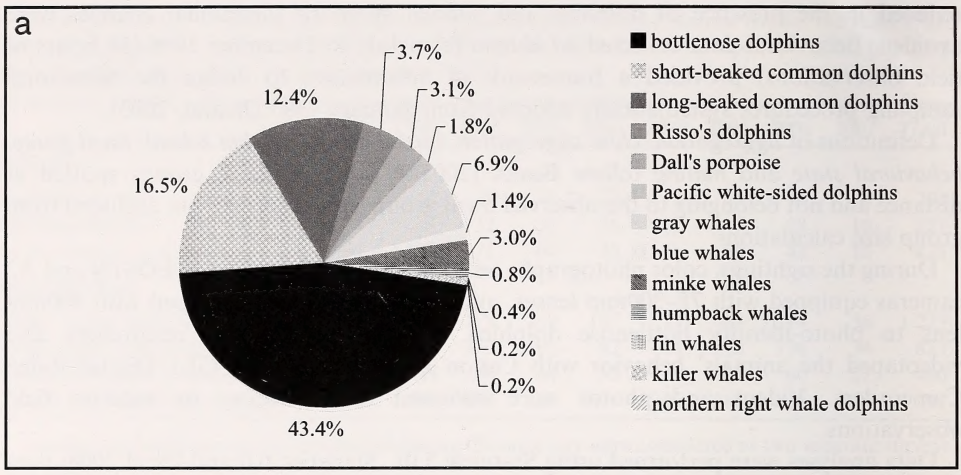
The majority of observations (94.1%, $n = 425$) were conducted in good conditions (Beaufort scale ≤ 2, sea state 0 and visibility > 300m) during 204 inshore and 221 offshore surveys. A total of 823 h were spent searching for cetaceans in good weather conditions; 400h were spent observing 509 cetacean groups encountered during sightings lasting on average 50 min (range 1-263 minutes; Table 1).

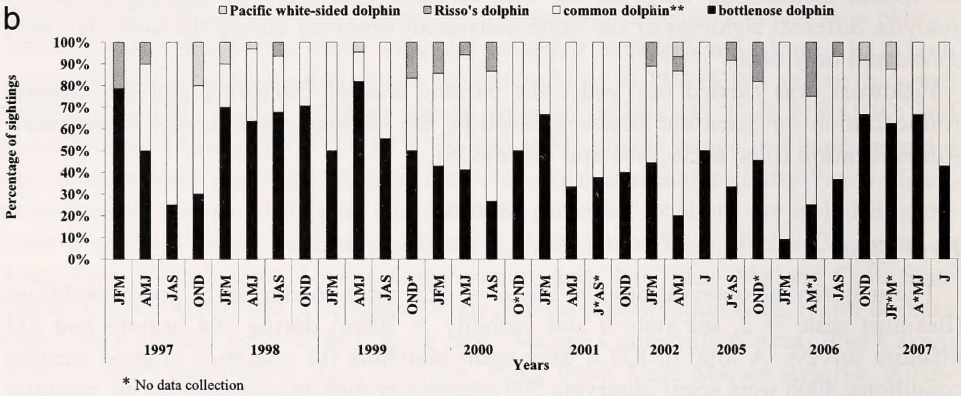
Occurrence, Frequency and Distribution

Percentage of sightings for all cetacean species and for the four most frequently observed species in the study area are presented in Figures 2a,b. Bottlenose dolphin was the species most frequently sighted (43.4%, *n schools* = 221), followed by short-beaked common dolphin (*Delphinus delphis*; 16.5%, $n=84$), and long-beaked common dolphin (*Delphinus capensis*; 12.4%, $n=63$; Table 2). Risso's dolphin (*Grampus griseus*), Dall's porpoise (*Phocoenoides dalli*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), gray whales (*Eschrichtius robustus*), blue whales (*Balaenoptera musculus*), minke (*Balaenoptera acutorostrata*), humpback (*Megaptera novaeangliae*) whales, fin whales (*Balaenoptera physalus*), northern right whale dolphins (*Lissodelphis borealis*) and killer whales (*Orcinus orca*) were sighted occasionally or during their migrations.

Although cetaceans were observed during the entire study period, a significant difference among the nine years of study was observed in the overall sighting numbers $t = 6.20$, $df = 8$, $P < 0.001$; Fig. 3).

Mixed groups were occasionally recorded in the bay (5.3% of total cetacean sightings, $n = 27$). The cetaceans found more often in inter-specific groups were offshore bottlenose dolphins associated with short-beaked and long-beaked common dolphins (44.4% of total mixed sightings, $n = 12$), followed by mixed groups of bottlenose dolphins and





* No data collection

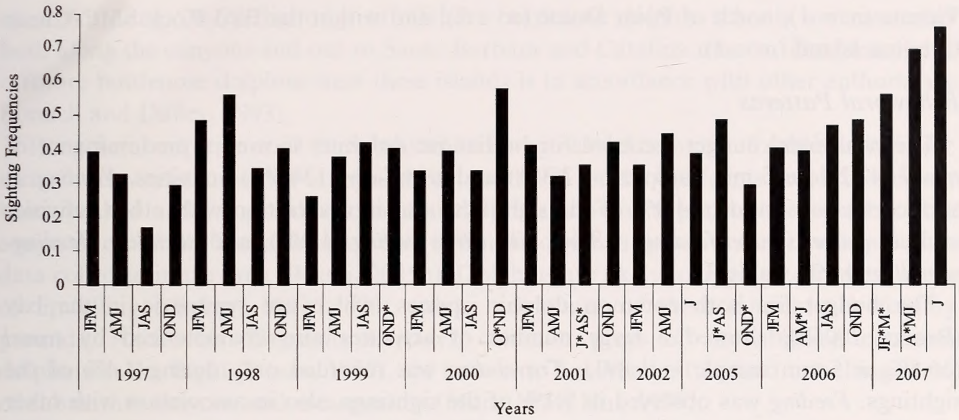
** This calculation includes *Delphinus spp.* not recognized at the species level.

Fig. 2a, b. (a) Percentage of sightings for cetacean species observed in the study area, and (b) percentage of sightings for the four most frequently observed species recorded during 3-month periods in Santa Monica Bay for the years 1997–2007. No surveys were conducted December 1999, October 2000, July 2001, September 2001, July 2005, December 2005, May 2006, and February-April 2007.

Table 2. Sighting frequencies (sightings/hour) of the three most observed cetacean species in the bay.

	1997	1998	1999	2000	2001	2002	2005	2006	2007	Total
Tursiops truncatus										
Number of sightings	19	61	33	24	20	7	10	29	18	221
Sighting frequency (sights/hour)	0.13	0.27	0.19	0.16	0.14	0.10	0.15	0.15	0.32	0.18
*Delphinus delphis**										
Number of sightings	6	7	6	6	15	9	8	19	8	84
Sighting frequency (sights/hour)	0.04	0.03	0.03	0.04	0.01	0.12	0.12	0.10	0.14	0.07
*Delphinus capensis**										
Number of sightings	2	12	10	9	4	4	3	16	3	63
Sighting frequency (sights/hour)	0.01	0.05	0.06	0.06	0.03	0.05	0.04	0.08	0.05	0.05

* *This calculation does not include* Delphinus spp. *not recognized at the species level.*


Sighting Frequencies
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
JFM AMJ JAS OND JFM AMJ JAS OND JFM AMJ JAS OND* JFM AMJ JAS O*ND JFM AMJ J*AS* OND JFM AMJ J JAS OND* JFM AM*J JAS OND JF*M* A*MJ J
1997 1998 1999 2000 2001 2002 2005 2006 2007
Years

* No data collection

Fig. 3. Cumulative cetacean sighting frequencies (sightings/hour) recorded during 3-month periods in Santa Monica Bay.

Risso's dolphins (29.6% of total mixed sightings, $n = 8$) and bottlenose dolphins and gray whales (7.4% of total mixed sightings, $n = 2$).

Bottlenose dolphins were observed mostly in inshore waters (81.4%, $n = 180$), but offshore schools were also recorded (18.6%, $n = 41$) outside the bay and out to Santa Barbara Island. Short-beaked and long-beaked common dolphins were observed mostly in offshore waters (98.3%), usually above escarpments and submarine canyons (62.7%, $n = 111$). Bottlenose dolphins and the two common dolphin species were often recorded within and outside the boundaries of the four coastal designed MPAs (Point Dume SMR and SMCA, Point Vicente SMCA, and Abalone Cove SMCA); bottlenose dolphins were also found within Bird Rock and Blue Cavern SMCAs near Catalina Island (Fig. 1a).

Gray whales were often recorded in inshore waters (31.4% of gray whale sightings, $n = 11$), but also near Santa Monica Canyon (12.1%, $n = 33$) and the escarpment near Point Vicente (30.3%, $n = 33$). Gray whales were observed within the boundaries of three designed MPAs: Point Dume SMR, Point Vicente and Abalone Cove SMCAs (n = 5).

All other cetaceans were seen exclusively in offshore waters (Fig. 1a). Risso's dolphin sightings occurred either in the bay, near the escarpment or the Santa Monica Canyon (47.4%, $n = 19$), or at more than 15km from shore. Risso's dolphins were also recorded within the Point Vicente SMCA (n = 1). Dall's porpoises also occurred mostly in the bay (93.7%, n = 16) and, with the exclusion of one sighting, always near Santa Monica and Redondo canyons or along the escarpment. They were found inside the Point Dume SMR once. Of a total of nine sightings, Pacific white-sided dolphins were observed exclusively inside the bay with no distinctive preference for any bathymetric feature; they were recorded twice within the Point Vicente and Abalone Cove SMCAs. Northern right whale dolphins and killer whales were both recorded near Dume Canyon and within the boundaries of the Point Dume SMR/SMCA. Minke whales and humpback whales where both recorded in the bay (minke whale: 80.0%, $n = 15$; humpback whale: 75.0%, $n = 4$), with a preference for slopes and escarpments. Humpbacks were found in vicinity of the Point Vicente SMCA. Both of the fin whale sightings were seen in offshore waters outside the bay. Of the seven sightings of blue whales, all of them occurred inside the boundaries of the established MPAs and along escarpments near Dume Canyon (n = 3), off Point

Vicente (n = 1), north of Point Dume (n = 2), and within the Bird Rock SMCA near Catalina Island (n = 1).

Behavioral Patterns

The behavioral budget recorded for bottlenose dolphins showed a predominance of *travel* (42.2%; *n* 5-min samples = 2,381) and *travel-dive* (24.5%) activities. *Feeding* at surface was observed in 4.0% of the sightings, also in association with other activities such as *travel* (*travel-feeding*: 5.9%), *dive* (*dive-feeding*: 1.3%), and *socialize* (*feeding-socialize*: 0.9%; Table 3).

The budget for both common dolphin species, which are sympatric in the bay (Bearzi, 2005b), showed a large number of activities also characterized by *travel* (56.5%; *n* 5-min sample = 1,891). *Travel-dive* was recorded only during 4.4% of the sightings. *Feeding* was observed in 9.1% of the sightings, also in association with other activities such as *travel* (*travel-feeding:* 12.3%), and dive (*dive-feeding*: 0.8%; Table 3). Both species of common dolphins were regularly observed separating into smaller groups of about 25–30 individuals to feed near the surface on large schooling fish (M. Bearzi, pers. obs.).

Pacific white-sided dolphins and Risso's dolphins spent most of the time *travel*ing in the study area (respectively: 46.3%; *n* 5-min sample = 108; 62.5%, *n* = 112), but other behavioral states were also observed. Dall's porpoises were mostly *dive-traveling* (36.5%, *n* = 74). Gray whales were regularly observed *traveling* (75.8%; *n* = 128) from Point Dume to Point Vicente and *vice versa* during their winter migration, but some individuals were also seen in the inshore waters (< 0.5 km) of the bay. Minke whales were mostly sighted during *dive-travel* activities (48.0%, *n* = 50; Table 3).

Group Size

Group sizes for the most observed species are illustrated in Table 4. The mean group sizes of coastal and offshore bottlenose dolphin schools varied considerably (mean difference = 7.71, df = 40, t = 3.86, $P < 0.001$), with the largest groups observed offshore. Both species of common dolphins were usually observed in large schools (mean = 108.84, SD = 122.66, SE = 9.52, range = 1–600, *n* = 166), and the largest group sizes were in offshore waters (mean = 115.98, SD = 123.83, SE = 9.95, range = 1–600, *n* = 155). Inshore common dolphins were mostly observed alone in aggregation with bottlenose dolphins. Minke whales and gray whales were usually observed alone or in pairs.

Discussion

Occurrence and Distribution

Of the cetaceans inhabiting the study area, bottlenose dolphins were the most often observed, followed by long-beaked and short-beaked common dolphins, as previously recorded for the Southern California Bight (Bonnell and Dailey, 1993; Forney and Barlow, 1998; Carretta et al., 2006). Other cetaceans were occasional or rare inhabitants of the bay and their occurrence reflects, in general and at smaller scale, the occurrence of these species reported by other authors for the SCB (Bonnell and Dailey, 1993; Barlow et al., 1998; Schmitt and Bonnell, 2003; Appler et al., 2004; Carretta et al., 2006; Soldevilla et al., 2006).

Coastal bottlenose dolphins were regularly observed close to shore, in agreement with data off the San Diego coastline (Defran and Weller, 1999; Defran et al., 1999; Dudzik et

al., 2005; Lang, 2002). Sightings of offshore bottlenose dolphin schools were recorded both along the canyons and out to Santa Barbara and Catalina islands. The presence of offshore bottlenose dolphins near these islands is in accordance with other authors (see Bonnell and Dailey, 1993).

The general occurrence of short-beaked and long-beaked common dolphins in offshore waters was consistent with Forney and Barlow (1998) for the California coast. In the bay, short beaked and long-beaked common dolphins showed a preference for submarine canyons, especially Santa Monica and Redondo canyons, in accordance with previous data collected in the area (Bearzi, 2005b). Dolphins are likely to aggregate in these areas of upwelling (Hickey, 1992, 1993), taking advantage of these nutrient-rich feeding grounds. Anchovies (*Engraulis mordax*), common preys of short-beaked common dolphins in the Bight (Evans, 1975), are known to be abundant around upwelling areas of submarine canyons and escarpments (Mais, 1974; Hui, 1979).

Prey abundance near these bathymetric features may also explain the presence of other cetacean species in the same areas. Competition for resources along canyons was probably avoided by: 1) different species of cetaceans feeding on different prey (Bearzi, 2005b), 2) the presence of species at different seasons at these locations, and, most likely, 3) productive feeding grounds rich enough in prey to support the feeding requirements of various species.

The most observed cetacean species occurred throughout the entire study period, including the strong 1997–98 El Niño (and following La Niña). The overall presence of cetaceans in the bay during El Niño years may have been related to prey abundance of some fish species, including Pacific sardine (*Sardinops sagax*), white seabass (*Atractoscion nobilis*) and splitnose rockfish (*Sebastes diploproa*), during this time of warmer water temperature (California Department of Fish and Game, 2000). Bottlenose and common dolphins are also known to be opportunistic feeders that change their diet based on availability and abundance (Heyning and Perrin, 1994; Bearzi et al., 1999).

The only exception to this trend was the Risso's dolphin that disappeared from the bay at the beginning of the 1997–98 El Niño and began to reappear in the area after the year 2000. This species was rarely observed before the 1982–83 El Niño event in southern California waters, but seemed to have increased above the continental shelf around Catalina Island after this event (Shane, 1995; S. Shane, pers. comm.). The disappearance of this species from the bay prior to and after the 1997–98 El Niño event may have been related to offshore movements of California market squid, *Loligo opalescens*, one of their common prey (Zeidberg et al., 2006).

In conclusion, the unique physical oceanography of the study area have shaped a suitable habitat for several species of prey and, consequently, for cetaceans. Santa Monica Bay could also act as an "oasis" during years of poor productivity, as has been documented for Monterey Bay during the 1997–1998 El Ninño (Benson et al., 2002).

Further studies on the relationships between oceanographic conditions, prey availability and the distribution and abundance of cetacean populations at different scales are needed to improve the understanding of the ecology of the local cetacean community.

Behavioral Patterns of the Most Observed Species

Behavioral data collected for bottlenose dolphins were comparable to those reported for the San Diego area (Hanson and Defran, 1993). Coastal bottlenose dolphins spent most of the time traveling (this study: 68.8% travel plus dive-travel; San Diego: 63.0%

Table 3. Overall behavioral state budget recorded for the most observed species. Behavioral state data at less than 0.5% level were not included in the table. A hyphen between two behavioral states refers to activities performed simultaneously by different focal group individuals during 5-min sample (e.g., Dive-Travel).

Species	Behavioral states	N 5-min Samples	Frequency distribution of observed behavioral states (approx. %)	Tot 5-min samples
Bottlenose dolphin	Travel	1,004	42.17	2,381
	Travel-Dive[a]	583	24.49	
	Travel-Socialize	199	8.36	
	Travel-Feeding	140	5.88	
	Feeding	96	4.03	
	Dive	44	1.85	
	Travel-Dive-Socialize	38	1.60	
	Socialize	37	1.55	
	Dive-Feeding	32	1.34	
	Travel-Milling	23	0.97	
	Travel-Dive-Milling	23	0.97	
	Feeding-Socialize	21	0.88	
	Travel-Dive-Feeding	17	0.71	
	Dive-Socialize	17	0.71	
	Travel-Dive-Socialize-Milling	15	0.63	
	Travel-Socialize-Milling	14	0.59	
	Dive-Socialize-Milling	7	0.29	
	Milling	4	0.17	
	Dive-Milling	3	0.13	
	Travel-Dive-Feeding-Socialize-Milling	3	0.13	
	Travel-Dive-Play-Socialize[b]	2	0.08	
	Socialize-Milling	2	0.08	
	Travel-Feeding-Milling	2	0.08	
	Dive-Feeding-Socialize	2	0.08	
	Travel-Dive-Feeding-Socialize	2	0.08	
	Travel-Dive-Feeding-Milling	2	0.08	
	Dive-Feeding-Milling	1	0.04	
	Feeding-Socialize-Milling	1	0.04	
	Dive-Feeding-Socialize-Milling	1	0.04	
	Travel-Feeding-Socialize-Milling	1	0.04	
Common dolphin[1]	Travel	1,069	56.53	1,891
	Travel-Feeding	232	12.27	
	Feeding	173	9.15	
	Travel-Socialize	135	7.14	
	Travel-Dive	84	4.44	
	Travel-Dive-Socialize	36	1.90	
	Dive	27	1.43	
	Travel-Feeding-Socialize	21	1.11	
	Travel-Dive-Feeding	20	1.06	
	Dive-Feeding	5	0.79	
	Socialize	8	0.42	
	Travel-Dive-Feeding-Socialize	8	0.42	
	Travel-Socialize-Milling	5	0.26	
	Travel-Milling	3	0.16	
	Travel-Dive-Milling	2	0.11	
	Travel-Dive-Milling-Feeding	2	0.11	
	Milling	1	0.05	

Table 3. Continued.

Species	Behavioral states	N 5-min Samples	Frequency distribution of observed behavioral states (approx. %)	Tot 5-min samples
	Travel-Milling-Feeding	1	0.05	
	Travel-Dive-Milling-Socialize	1	0.05	
Risso's dolphin	Travel	70	62.50	112
	Travel-Feeding	9	8.04	
	Travel-Dive	8	7.14	
	Travel-Socialize	6	5.36	
	Feeding	3	2.68	
	Dive-Feeding	2	1.79	
	Travel-Dive-Feeding	2	1.79	
	Milling	2	1.79	
	Dive-Milling-Feeding	1	0.89	
	Travel-Milling	1	0.89	
Dall's porpoise	Travel-Dive	27	36.49	74
	Dive	21	28.38	
	Dive-Feeding	15	20.27	
	Travel	10	13.51	
	Travel-Milling	1	1.35	
Pacific white-sided dolphin	Travel	50	46.30	108
	Travel-Socialize	20	18.52	
	Feeding	8	7.41	
	Travel-Feeding	7	6.48	
	Travel-Dive	4	3.70	
	Feeding-Socialize	4	3.70	
	Dive-Milling	4	.70	
	Dive	3	2.78	
	Milling	3	2.78	
	Travel-Play	3	2.78	
	Travel-Dive-Play	1	0.93	
	Travel-Dive-Feeding	1	0.93	
	Travel-Dive-Socialize	1	0.93	
Gray whale	Travel	97	75.78	128
	Travel-Dive	27	21.09	
	Dive	3	2.34	
	Feeding	1	0.78	
Minke whale	Travel-Dive	24	48.00	50
	Travel	12	24.00	
	Feeding	8	16.00	
	Dive	6	12.00	

[1] this data includes both species of short-beaked and long-beaked common dolphins.

[a] simultaneous behavior occurring during 5-min sample.

[b] the behavioral state *play* was only used in data collected during 2005–2007.

travel plus dive-travel), and feeding was observed 19.0% of the time along the San Diego coastline and 13.2% in the study area.

Data on behavioral patterns of free-ranging common dolphins (*Delphinus* spp.) are scarce worldwide (Neumann, 2001b). Data for short-beaked common dolphins in the study

Table 4. Group sizes for the nine most observed species and mean group sizes reported by other authors.

	Mean	SD	SE	Count	Min	Max
Bottlenose dolphin	9.94	7.59	0.53	203	1	57
Inshore	8.30	5.01	0.39	162	1	35
Offshore	16.41	11.66	1.82	41	1	57
Common dolphin[1]	108.84	122.66	9.52	166	1	600
Inshore	8.27	13.61	4.10	11	1	40
Offshore	115.98	123.83	9.95	155	1	600
Pacific white-sided dolphin	17.27	10.40	3.13	11	5	45
Dall's porpoise	6.67	4.56	1.32	12	2	15
Risso's dolphin	9.67	7.35	1.90	15	3	29
Gray whale	1.70	0.70	0.15	23	1	3
Minke whale	1.33	0.50	0.17	9	1	2

	Mean	Sources
Bottlenose dolphins	19.8	Defran and Weller (1999), San Diego, inshore dolphins
	18	Hansen (1990), Southern California, offshore dolphins
	15.7	Lang (2002), San Diego, inshore dolphins
	12.7	Lang (2002), Santa Barbara, inshore dolphins
	10	Scott and Chivers (1990), Eastern tropical Pacific Ocean, inshore dolphins
	9.1	Dudzik et al. (2005), San Diego, inshore dolphins
Common dolphin	67.1	Shane 1994, Catalina Island, California
	98	Au and Perryman 1985, Eastern Tropical Pac.
	77.6	Smith et al. 1986, California Current
	5.4–661.5	Barlow 1995, California waters
Pacific white-sided dolphin	10.3	Shane 1994, Catalina Island, California
	11.5–75.4.1	Barlow 1995, California waters
Dall's porpoise	4.7	Shane 1994, Catalina Island, California
	4.5	Smith et al. 1986, California Current
	3.3	Barlow 1995, California waters
Risso's dolphin	13.1	Shane 1994, Catalina Island, California
	8.3–25.2	Barlow 1995, California waters
Gray whale	2.1	Reilly et al. 1983, California shores
	3–5.3	Forney et al. 1995, California waters
Minke whale	1.1	Barlow 1995, California waters
	1.0	Forney et al. 1995, California waters
	1.8	Shane 1994, Catalina Island, California

[1] group sizes for *D. delphis* and *D. capensis* are cumulated for comparison with other authors.

area were consistent with observations for the same species in the north-western Bay of Plenty, in New Zealand, where dolphins were seen mostly traveling (55.0% Neumann, 2001b; 57.0% this study). In Santa Monica Bay, both species of common dolphins spent more time traveling, foraging and feeding at surface than bottlenose dolphins (Table 3). The large amount of time spent traveling by both species of common dolphins was probably related to the distribution and availability of prey in the pelagic environment of the bay that required movements between different foraging grounds (Bearzi, 2005b).

Group Sizes of the Most Observed Species

Mean group sizes for the most common cetaceans observed in Santa Monica Bay and adjacent areas were comparable to group sizes reported by other authors for the SCB

(Table 4). Coastal bottlenose dolphin groups observed in the bay ranged from 1 to 35 individuals and were typically composed of 2–15 individuals. Offshore bottlenose dolphin groups ranged from 1 to 57 individuals and were typically composed of 10–20 individuals. The results of this study are similar to Hansen (1990) and Scott and Chivers (1990). This species showed an increased group size from inshore to offshore waters, in agreement with Defran and Weller (1999), likely as a response to the patchily distributed food resources of the pelagic environment (Wells et al., 1980; Dailey et al., 1993).

Offshore bottlenose dolphins were also found in aggregations with other cetaceans (Bearzi, 2005a), possibly facilitating schooling behavior of prey and capture of food by these predators (Magurran, 1990; Similä and Ugarte, 1993; Norris and Johnson, 1994).

Both species of common dolphins were regularly observed in large schools, and often recorded in rank formation during food search, spreading out over a mile (M.Bearzi, pers. obs.). When a high concentration of prey was found, dolphins separated into smaller groups of 25–30 individuals, and exploited the resources present in different feeding grounds. The presence of these subgroups is in agreement with Evans (1994), suggesting a basic social unit for common dolphins of about 30 individuals.

Cetacean Community and the Newly Established MPAs

Recently, many investigations on dolphins and whales (*e.g.*, Gregr and Trites, 2001; Harwood, 2001; Fury and Harrison, 2008) have helped to identify key areas for cetaceans and, in some cases, have contributed to the establishment or expansion of marine protected areas (Dawson and Slooten, 1993; Hooker *et al.*, 1999; Hoyt, 2005). Vice versa, some MPAs have helped to protect cetaceans and their habitats, as well as the species they feed upon (Hoyt, 2005).

Based on this study: 1) the presence of a rich and diverse cetacean fauna in the study area, that includes several threatened and endangered species, 2) the year-round and regular occurrence of three dolphin species, including the bottlenose dolphins frequenting coastal waters, 3) the use of this areas as foraging grounds by several cetaceans species, are all clear indications of the importance of these habitats for the local cetacean community.

Several of the MPAs located in the study area represent foraging hotspots and/or essential corridors for year-round species like bottlenose dolphins, short-beaked and long-beaked common dolphins (this study, Bearzi, 2005a,b; Bearzi, *et al.*, 2009a), as well as habitats in which endangered cetaceans like blue whales are found (this study). Protecting these critical habitats for cetaceans as well as the species they depend upon is the first step toward good management of MPAs (Hoyt, 2005).

Coastal bottlenose dolphins inhabiting the impacted waters off Los Angeles (Schiff, 2000) year-round and using the area as foraging ground (this study; Bearzi, et al., 2009a), are top predators susceptible to indirect threats like marine debris, chemical and acoustic pollution (Simmonds and Hutchinson, 1996; Nowacek et al. 2007, Weilgart 2007, Stavros et al. 2008). Anthropogenic effects on these animals are usually difficult to assess, but dolphins bioaccumulate toxins and suffer immunological and reproductive disorders as a consequence (Simmonds and Hutchinson, 1996; Bossart 2007; Blasius and Goodmanlowe, 2008). Over 80% of bottlenose dolphins in the study area were found carrying skin diseases and body malformations (Bearzi et al., 2009). These diseases are usually correlated to poor quality of water and presence of contaminants (Bossart, 2007). Bottlenose dolphins are now used worldwide as key indicators of the status and health of coastal habitats because they represent important marine ecosystem sentinels (Wells et

al., 2004). Long-term population monitoring data on these dolphins are a powerful tool for tracking the progression of poorly understood diseases that may be relevant both to dolphin and human health.

In general, cetaceans are often viewed as flagship species (Mann et al., 2000; Prideaux, 2005). In the study area , and the established MPAs within, there is a substantial overlap in distribution between cetaceans and other apex and non-apex species (e.g. seabirds, fish, zooplankton; Bearzi, 2005). The overlap usually coincides with upwelling and nutrient-rich feeding areas. Conservation measures aimed at mitigating threats to cetaceans are expected to result in protection for other organisms as well.

Continuous monitoring is essential to identify not only the areas used preferentially by cetaceans within and outside the boundaries of the MPAs, but also the subset of critical habitats they use for different behavior, and the type of behaviors in which they are most vulnerable to human activities. Monitoring distribution, occurrence and behavior of these key species, as well as their threats, is essential in any decision-making process involving MPAs, as has also been suggested at the last International Committee on Marine Mammal Protected Areas (http://icmmpa.org/).

In conclusion, this paper provides new ecological baseline data on dolphins and whales, and offers preliminary information for better establishing goals for use of the newly established MPAs (e.g., control of human activities such as fishing, whale watching). The implication for MPA design and implementation in the study area is that a more flexible definition of MPAs for these cetaceans is needed. It also stresses the strong need of regular and long-term monitoring of cetaceans within and outside the boundaries of the MPAs. This will help to keep the definition of MPAs more adaptable, thereby facilitating the changes necessary to protect cetaceans, as well other species present in the areas.

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Comments on Microhabitat Specialization and a Depth Range Extension for a Chaenopsid Tube Blenny in the Gulf of California, Mexico

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Acanthemblemaria balanorum Brock (Clubhead Blenny; Fig. 1) is a chaenopsid tube blenny endemic to the Tropical Eastern Pacific. Adults of this species, as all members of the Chaenopsidae, inhabit vacated invertebrate tubes or tests (Stephens 1963; Lindquist 1985). In the case of *A. balanorum*, the shelter of choice is the vacated test of *Megabalanus* Hoek barnacles, a genus characterized in the Tropical Eastern Pacific by a complex of species (Henry and McClaughlin 1986) that typically live in the upper 10 m on shallow rocky reefs (Brusca and Hendrickx 2008). In the Gulf of California (GOC), Mexico, *A. balanorum* overlaps in distribution with two congeners, *A. crockeri* Beebe and Tee-Van and *A. hastingsi* Lin and Galland, and these species are known to exhibit depth partitioning, with *A. balanorum* inhabiting relatively shallower depths, *A. crockeri* inhabiting relatively deeper depths, and *A. hastingsi* overlapping near the edges of the depth ranges of the other two species at intermediate depths (Lindquist 1985). A detailed study of the relationships among these three congeners in the southern GOC (Lindquist 1985) reported that *A. balanorum* inhabits shelters (=barnacles) down to approximately 7 m depth. Guides to the fishes of the region (e.g., Allen and Robertson 1994; Humann and DeLoach 2004) report a similar depth range.

In November 2010, I observed and collected several individuals of *A. balanorum* at a depth of 21 m at the base of a pinnacle off the south end of Maria Cleofas, the southernmost point in the Islas Marias archipelago, southern GOC. These individuals, like all individuals of this species that I have observed, inhabited vacant barnacles (*Megabalanus*). This observation represents a significant depth range extension for this normally shallow subtidal fish (and may also represent an extension for the barnacle; Brusca and Hendrickx 2008). This ability of a microhabitat specialist to colonize abnormal macrohabitats (in this case much deeper than normal waters) when its microhabitat (=barnacles) is available supports a hypothesis that these specialists are resource (=shelter) limited. Similar shelter limitation has already been experimentally demonstrated in the GOC congener, *A. crockeri*, which increases in average density with shelter addition (Hastings and Galland 2010).

I observed additional evidence that *A. balanorum* is a shelter-limited microhabitat specialist in July 2009 at Las Animas, a small island and a series of small pinnacles in the central GOC. That site proved to be ideal *A. balanorum* habitat, with several large boulders completely covered by broad, very dense *Megabalanus* fields down to 5 m depth. Within these barnacle fields, I observed large numbers of *A. balanorum*, more densely distributed than any other chaenopsid population reported to date (e.g. in Lindquist 1985; Clarke 1996; Thomson and Gilligan 2002; P.A. Hastings, pers. comm.). During an opportunistic survey of the area, I placed a 0.25 m^2 quadrat on five randomly selected areas on the top of a large, flat boulder at 5 m depth in order to survey chaenopsids and

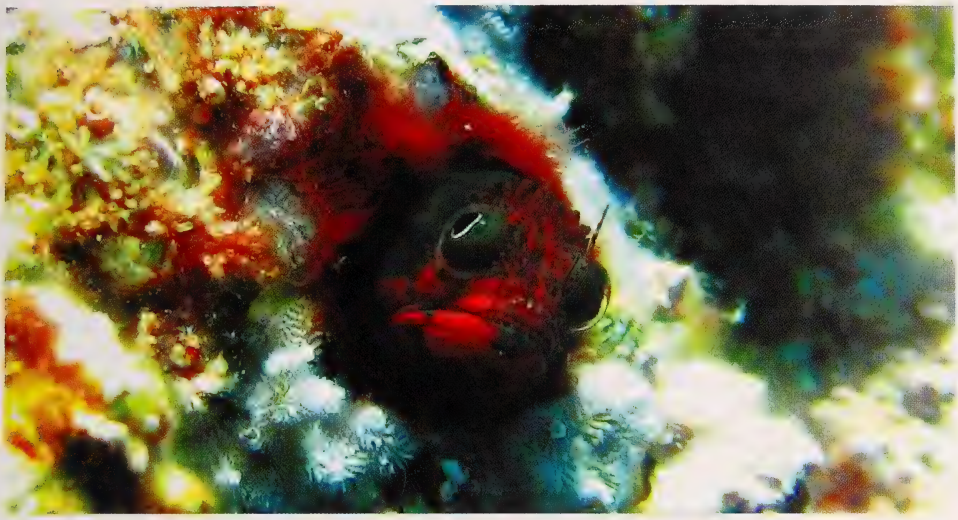

Fig. 1. *Acanthemblemaria balanorum* in shelter at Las Animas in the central Gulf of California, Mexico. Photo taken in July 2009 at 5 m depth during nearest neighbor surveys. Photo by J. Lund.

ascertain densities. Numbers of *A. balanorum* ranged (mean +/− SD) from 8 – 28 (20.4 +/− 8.6) individuals per 0.25 m^2. These high densities may reflect the very high barnacle densities at this site, though it is difficult to quantify available shelters, as it is not immediately obvious what a chaenopsid considers to be a sufficient shelter.

To date, no experiments have been designed to determine what a second limiting factor is for these or similar shelter-dwelling microhabitat specialists, but it is quite possibly an issue of territory size. Males of *Acanthemblemaria* and several other chaeonpsid genera actively court females, which, upon choosing a suitable male, enter the male's shelter and deposit eggs (Hastings 1986; Hastings 1988; Hastings and Peterson 2011). The males guard the eggs and may simultaneously protect clutches from multiple females (Hastings 1986; Hastings 1988; Hastings and Peterson 2011). Under these conditions, males compete for female choice and for the most desirable shelters (Hastings 1988; Hastings 1992). The high densities of *A. balanorum* observed at Las Animas could lead to agonistic interactions that secondarily limit the population size (or density) of this species.

In order to begin quantifying the distance between occupied barnacle shelters at the densely populated Las Animas site, I randomly chose an individual *A. balanorum* and measured the distance to its nearest neighbor. I then measured the distance to that individual's nearest neighbor and repeated the process until I reached ten total individuals. On average (SD), these ten individuals were only 4.4 cm (1.6) from their nearest neighbor. Upon collecting the specimens, I obtained sex and standard length (SL) for each individual and determined that they were, on average (SD), 28.9 mm SL (3.8) and were all sexually mature adults. In fact, to the best of my knowledge, juvenile habitat preference in this species is unknown. The male to female sex ratio was 7:3, indicating the ability of several adult males to live in close proximity to one another and to mature females, which were somewhat evenly dispersed among the males, within this set of ten individuals (numbers one, three, and eight out of ten; 5, 2.5, and 5 cm from their nearest neighbors, respectively). The presence of some shelters inhabited by less competitive

chaenopsid species, *Coralliozetus angelicus* (Böhlke and Meade) and *Protemblemaria bicirrus* (Hildebrand), increases the overall chaenopsid density, and the availability of some uninhabited shelters perhaps implies that the community at that site is approaching some maximum. It is difficult, however, to determine whether or not empty barnacles represent a choice to avoid high densities, a preference for other more highly desirable shelters, or some additional factor.

While the preliminary evidence presented here supports a hypothesis that these microhabitat specialists are first limited by the presence of their preferred shelter and then by some other factor (possibly territoriality) that prevents higher densities, even with greater shelter availability, it is necessary to design and implement experiments to test this and similar hypotheses empirically. Species like *A. balanorum* that rely on biologically derived microhabitats may be able to utilize a wider range of macrohabitats as their "hosts" move to new areas. In the case of the depth range extension at Maria Cleofas, the ability of *Megabalanus* barnacles to survive down to at least 21 m at this site allows a species that specializes on its empty tests to do the same, and this ability is not unique to *A. balanorum*. A blenniid (*Hypsoblennius brevipinnis* Günther) and another chaenopsid (*A. macrospilus* Brock) were observed and collected at the Maria Cleofas site, inhabiting barnacle tests. *Hypsoblennius brevipinnis* is also a microhabitat specialist, its preferred shelter is also *Megabalanus*, and it is typically confined to the upper 3–4 m of the subtidal zone (Allen and Robertson 1994; Humann and DeLoach 2004; though it may be known from as deep as 10 m; De la Cruz Agüero et al. 1997). Like in *A. balanorum*, this observation represents a significant depth range extension for this specialist and an interesting finding for the Blenniidae, which are characterized by few species reaching depths greater than approximately 25 m (Springer and Smith-Vaniz 1970). *Acanthemblemaria macrospilus*, sister to the more northern *A. hastingsi* discussed above (see Lin and Galland 2010), shares its ability to utilize multiple microhabitat shelters (Lindquist 1985) and typically lives to depths of 15–18 m (Allen and Robertson 1994). Observation of individuals at a depth of 21 m may represent a minor change in depth range, but its flexibility in shelter choice probably allows it to occupy a greater diversity of habitats than *A. balanorum*. Further research into the intra- and interspecific relationships within this group of species that utilize (and potentially compete for) similar microhabitats will reveal more of the processes at play in determining the makeup of this assemblage and may provide further insight into the relative advantages and disadvantages of microhabitat specialization.

All specimens of all species discussed here were collected using quinaldine and are archived at the Scripps Institution of Oceanography Marine Vertebrate Collection (Las Animas collection number = SIO 09-261; Maria Cleofas collection number = SIO 10-132).

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Reproduction of the Cape Horned Lizard, *Phrynosoma coronatum* (Squamata: Phrynosomatidae) from Baja California Sur, Mexico

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Species of *Phrynosoma* (formerly *P. coronatum*) range west of the Sierra Nevada from Shasta County, California, south through southern California and Baja California (Grismer 2002). Montanucci (2004) and Leaché et al. (2009) considered *Phrynosoma* from the southern tip of Baja California as *P. coronatum*. Goldberg (1983) reported on reproduction in *Phrynosoma blainvillii* (as *P. coronatum*) from southern California. To my knowledge, there is no information on reproduction of *P. coronatum* from the Cape Region of Baja California Sur, Mexico. The purpose of this note is to report the results of a histological examination of *P. coronatum* gonads from the Cape Region of Baja California Sur to ascertain whether geographic variation in reproduction exists between northern and southern species of *Phrynosoma* (formerly *P. coronatum*, *sensu* Montanucci 2004, Leaché et al. 2009).

A sample of fourteen *P. coronatum* consisting of seven adult males (mean SVL = 76.9 mm ± 9.1 SD, range: 61–90 mm), five females (mean SVL = 79.2 mm ± 14.0 SD, range: 67–103 mm), one presumed neonate (SVL = 27 mm) and one presumed young of the year (SVL = 36 mm) was examined from the herpetology collection of the Natural History Museum of Los Angeles County (LACM), Los Angeles, California, U.S.A. (Appendix). *Phrynosoma coronatum* were collected 1964, 1967 and 1968.

For histological examination, the left testis was removed from males and the left ovary was removed from females. Enlarged follicles (> 5 mm length) were counted. Tissues were embedded in paraffin and cut into sections of 5 µm. Slides were stained with Harris hematoxylin followed by eosin counterstain (Presnell and Schreibman 1997). Slides of testes were examined to determine the stage of the spermatogenic cycle. Slides of ovaries were examined for the presence of yolk deposition. An unpaired *t*-test was utilized to compare *P. coronatum* male and female mean body sizes (SVL) using Instat (vers. 3.0b, Graphpad Software, San Diego, CA). Histology slides were deposited in LACM.

There was no significant size difference (mean SVL) between males and females of *P. coronatum* (unpaired *t* test, $t = 0.35$, $df = 10$, $P = 0.73$). The only stage present in the testicular cycle was spermiogenesis (sperm formation) in which the lumina of the seminiferous tubules were lined by clusters of sperm and/or metamorphosing spermatids. This condition was noted in the following monthly samples: (July, $n = 1$; August, $n = 6$). The testes were previously removed leaving the epididymides in one August male (LACM 109380). Tubules of the epididymis were filled with sperm so it was assumed the missing seminiferous tubules were undergoing spermiogenesis. The smallest spermiogenic male (LACM 19904) measured 61 mm SVL and was from August.

Monthly stages in the ovarian cycle are in Table 1. Three stages were noted: (1) quiescent, no yolk deposition; (2) early yolk deposition, basophilic yolk granules in the ooplasm; (3) enlarged ovarian follicles > 5 mm. One female from July (LACM 101500)

Table 1. Monthly stages in the ovarian cycle of five *P. coronatum* from Baja California Sur, Mexico.

Month	*n*	Quiescent	Early yolk deposition	Enlarged follicles > 5 mm
July	2	0	1	1
August	2	1	1	0
October	1	1	0	0

contained 12 enlarged follicles (> 5 mm) that would have ovulated later in the summer. This is within the range of 7–16 clutch sizes reported by Goldberg (1983) for *P. blainvilli* (as *P. coronatum*) females from southern California. This was also the smallest reproductively active female (SVL = 71 mm). One female from August (LACM 19907) exhibited early yolk deposition which would have resulted in an egg clutch being produced during the coming autumn.

One presumably neonate (LACM 101504, SVL = 27 mm) was collected 17 July and one juvenile (LACM 19905, SVL = 36 mm) was collected 9 August both indicating *P. coronatum* commenced reproduction earlier in the year.

My data indicate a significantly longer reproductive cycle for *P. coronatum* from the Cape Region of Baja California Sur as compared to *P. blainvillii* in southern California (Goldberg 1983). In southern California *P. blainvillii* (formerly *P. coronatum*) is a "spring breeder" in which reproductive activity commences in March and ends by July (Goldberg 1983). In the Cape Region of Baja California Sur, reproduction of *P. coronatum* occurs through summer. Also, the appearance of a presumed neonate in July and a larger presumed young of the year in August suggest that *P. coronatum* commenced reproduction earlier in spring, perhaps concurrent with northern species of *Phrynosoma* (sensu Montanucci 2004, Leaché et al. 2009). Furthermore, winter activity has been reported for *P. coronatum* in the Cape Region (Vandenburgh 1895, Leviton and Banta (1964). In view of the extended reproductive season in the Cape Region, it appears females of *P. coronatum* may routinely produce two clutches per season, although this has yet to be observed. Goldberg (1983) indicated two clutches might be possible for some *P. blainvillii* (as *P. coronatum*) females from southern California. In contrast, Howard (1974) reported one clutch was produced by *Phrynosoma* from northern Baja California.

Acknowledgements

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Appendix

Phrynosoma coronatum from the Cape Region of Baja California Sur examined from the herpetology collection of the Natural History Museum of Los Angeles County (LACM), Los Angeles, California U.S.A. (LACM 19903, 15 km E San Bartolo), (LACM 19904, 19905, 19906, vic. Santiago), (LACM 19907, 38 km NW La Paz), (LACM 101500, 101502, 101503, 101504, 101506, 109378, 109379, 109380, 109381, La Paz).

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A Previously Unreported Locality Record for the Gila Monster (*Heloderma suspectum*)

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Although the Gila Monster (*Heloderma suspectum*) is widely distributed throughout the Sonoran and portions of the Mojave Deserts of the southwestern United States and northwestern Mexico, details of its distribution in California are imperfectly known, due to the apparent rarity of the species in that state. In their review of Gila Monster records for California, Lovich and Beaman (2007) documented only 26 credible sightings during a period of 153 years. In May 2009 another sighting in California was documented by Ruppert (2010a, b) who photographed a specimen in the Providence Mountains, an area known for previous Gila Monster sightings (Lovich and Beaman 2007). In this paper we report the 28th credible record of a Gila Monster in California.

In their review of factors affecting the distribution of Gila Monsters in California, Lovich and Beaman (2007) noted that all previous records except one were east of approximately −116° longitude, corresponding to that portion of the eastern Mojave Desert that receives more than 24 percent of annual precipitation during the warm season (1 July–14 October). They also noted that the majority of records with dates represented observations in April and May. Habitat varied but most observations occurred in mountainous terrain with rocky, incised topography ranging from near sea level to over 1,200 m. Many sightings were in riparian or xeroriparian areas. Based on the ecological attributes considered important in the distribution of the species, Brown and Carmony (1991) and Lovich and Beaman (2007) predicted that future sightings might be reported from the Granite[1], Whipple, Turtle, and Chemehuevi Mountains of California. To date, that prediction has not been fulfilled to the best of our knowledge.

While conducting geological mapping for his Ph.D. dissertation (Haxel 1977), the junior author observed a Gila Monster at close range on the south side of Black Mountain in the southern Chocolate Mountains of southeasternmost California (Fig. 1), at an elevation of 300 ± 60 m. This area is underlain mainly by quartzofeldspathic schist (Orocopia Schist), sandstone and argillite (Winterhaven Formation), rhyolite porphyry, conglomerate, basalt, sand and gravel, and colluvium. Much of the landscape is dominated by resistant outcrops and boulders of the basalt that caps Black Mountain. Vegetation, typical of the lower Sonoran Desert, is dominated by sparse creosote bush and cacti, with small ironwood and palo verde trees along drainage ways and washes. The date was 30 April, 1974, during the time of year when most Gila Monsters have been observed in California. The sighting location lies within the rectangle bounded by UTM gridlines E = 0701000 and 0703000, N = 3656000 and 3658000 (where E and N denote

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[1] It is unclear which Granite Mountain range was suggested by Brown and Carmony (1991) as there is one near the Turtle Mountains that already has a Gila Monster record (Tinkham 1971; Lovich and Beaman 2007) and another, farther north along Interstate 40, without known records.

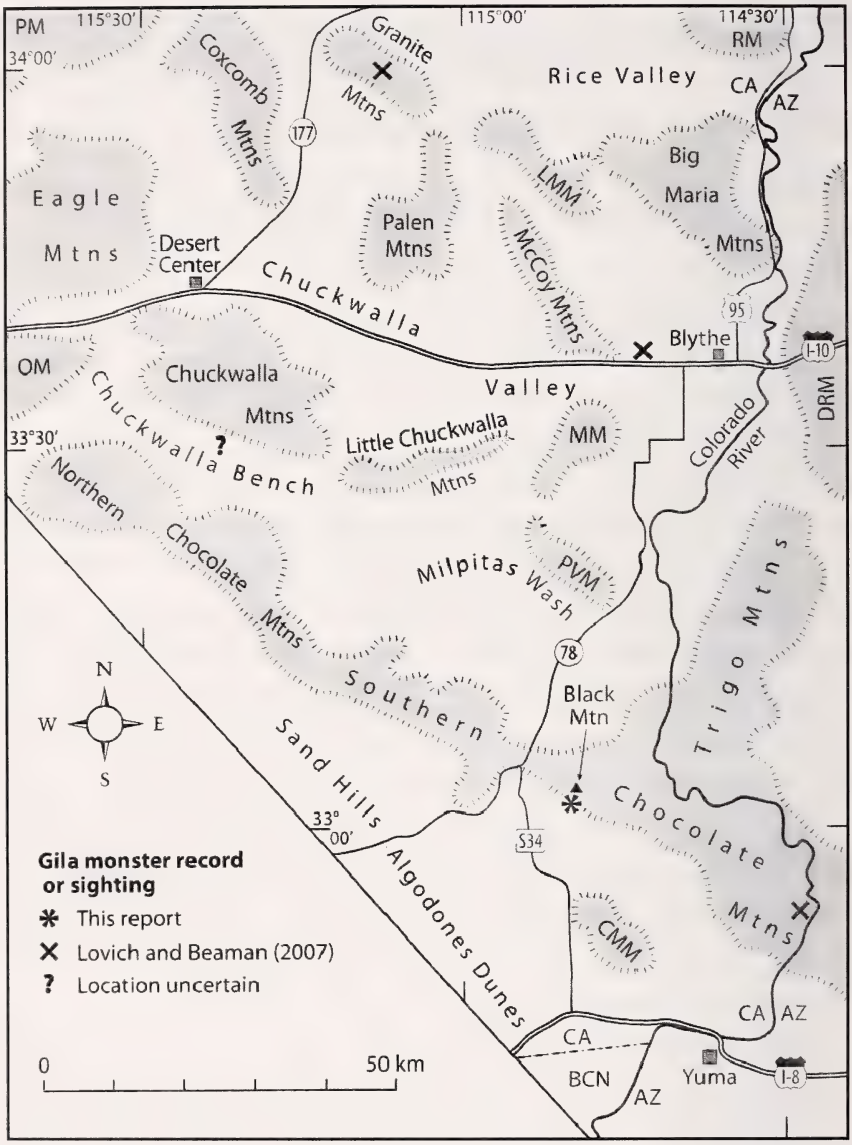

Fig. 1. The five Gila Monster records and sightings in the southeast corner of California. CMM, Cargo Muchacho Mountains; DRM, Dome Rock Mountains; LMM, Little Maria Mountains; MM, Mule Mountains; OM, Orocopia Mountains; PM, Pinto Mountains; PVM, Palo Verde Mountains; RM, Riverside Mountains.

easting and northing, the UTM zone is 11, and the datum is NAD 27). This area, in the Quartz Peak 7.5′ quadrangle (1988), is ≈ 2 km south-southwest of the prominent cluster of communications towers on Black Mountain. Consistent with most other Gila Monster records for the state, this locality is east of −116° longitude at about −114.83°. Distances to the two closest records for California Gila Monsters reported by Lovich and Beaman (2007) to the location were ≈ 38 km (Imperial Dam) and ≈ 65 km (Blythe airport).

Assuming that the sighting was unremarkable at the time, Haxel made a casual annotation in the margin of his copy of Jaeger (1957) *The North American Deserts*, next

to the description of the Gila Monster. By the time of the sighting Haxel had been mapping in the southern Chocolate Mountains for more than two years, and was quite familiar with the only other large lizard species in the area, the Common Chuckwalla (*Sauromalus ater*). By late April, most days he was seeing chuckwallas regularly, and periodically watched through binoculars as they fed on desert vegetation. Since that time, Haxel has seen about a half dozen other Gila Monsters in Arizona; Nevada; and Sonora, Mexico further confirming his identification of the specimen seen in the Chocolate Mountains.

While compiling Gila Monster records for California, Lovich came across correspondence from Mr. Frank Hoover, a biologist formerly employed with the California Department of Fish and Game, suggesting another record from the region of the Chocolate Mountains. Mr. Hoover had a note in his files that was given to a colleague at an interagency meeting probably over 30 years ago (date unknown). The handwritten note states: *"3 years ago we (two fellow rockhounds) saw a 4 foot long Gila monster coiled inside a hollow tree. Its body had about 6" diameter and filled the trunk hollow cavity – on the north side of the Chuckwalla Bench."* The writer of the note is unknown. Mr. Hoover considered it a sighting of a Gila Monster and forwarded it to another colleague as such.

The Chuckwalla Bench lies between the Chuckwalla Mountains to the north and the northern Chocolate Mountains to the south (Fig. 1), and inclines southward. Its northern edge is ≈ 750 m in elevation. The reported size of the animal is more than twice the record size for Gila Monsters (Beck, 2005) and the coiled posture noted suggests that the observers actually saw a large rattlesnake (*Crotalus* sp.). However, seeing a rattlesnake in the California desert is not an uncommon event, especially for rockhounds exploring the region, and a rattlesnake sighting would not be expected to result in a written report to a wildlife agency. Given that the Chuckwalla Bench is fairly close to the Chocolate Mountain record reported herein, and the records of Tinkham (1971) for California and Funk (1966) for nearby Arizona, it is possible that the observer actually saw a Gila Monster and greatly exaggerated its size, a common phenomenon when non-herpetologists see a large reptile (Pope 1961; see also http://www.giantconstrictingsnakes.com/AcceptableEvidence.html). We report the record in the interests of full disclosure and completeness because of its proximity to Haxel's sighting and leave it to the reader to decide its reliability. The Chuckwalla Bench and Chuckwalla Mountains are characterized by rocky, deeply incised topography, with scattered springs and extensive wash woodlands suggestive of Gila Monster habitat in Arizona (Beck, 2005), and would be good candidates for focused searches of this species in California, especially now that a credible record exists from the nearby Chocolate Mountains.

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ANNUAL MEETING

SOUTHERN CALIFORNIA ACADEMY OF SCIENCES

May 6–7, 2011

California State Polytechnic University

Pomona, CA

ABSTRACTS IN ALPHABETICAL ORDER

1. CAN YOU USE FLORAL TRAITS TO PREDICT POLLINATORS?

Cassidy Adlof, Yohanier Fernandez, and Dr. Ruben Alarcón. CSU Channel Islands, Department of Biology, Camarillo, CA, 93012.

The pollination syndrome hypothesis suggests that specific floral traits, such as color and shape, can be used to predict the pollinator. However, recent community-level studies have shown that pollination syndromes may not be as accurate in predicting pollinators as previously thought. In this study we test the pollination syndrome hypothesis by compare the floral traits from several plant-pollinator communities from California to observed interactions. Floral traits were first scored using digital images and then analyzed using a non-metric multidimensional scaling to produce a floral phenotypic space. We then performed additional tests to determine if floral morphology is correlated with visits from specific pollinator taxa. Our results suggest that pollinator taxa do not restrict their visits to flowers with particular trait combinations, but are rather generalized. Thus, it appears that the pollination syndrome hypothesis may be limited in predicting plant-pollinator interactions in a community context.

2. A REVIEW OF THE SYSTEMATICS OF THE GENUS SQUATINA IN THE EASTERN PACIFIC OCEAN

Alioto-Jurado D. 1*UCLA.

The systematics of the genus *Squatina* occurring in the Eastern Pacific (EP) have been poorly understood and historically the subject of debate. Currently there exist two valid described species *Squatina californica* and *Squatina armata* which are both harvested in fisheries in some parts of their ranges. Effective conservation and management strategies for these species require a fundamental understanding of their population structures. If their geographic ranges contain genetically distinct sub-populations, management guidelines based on large geographic areas could be inappropriate and lead to the permanent loss of small regional populations and any endemic alleles the sub-population may have contained. Observations in previous studies have suggested that a *S. californica* sub-population in the Gulf of California may even constitute a third distinct species. This study's objective is to clearly define how many distinct species occur in the Eastern Pacific (EP) and further identify the intra- and interspecific population structures by utilizing classical morphometrics and a suite of polymorphic microsatellite markers. Several specimens from both preserved collections and field expeditions were morphologically measured using a newly modified protocol specifically designed for the body shape of angel sharks and also sampled for genomic DNA fragments. Classical morphometric results will be presented with up to the date completed genetic analysis.

3. FUNCTIONAL STRUCTURE OF SOFT-BOTTOM FISH COMMUNITIES OF THE SOUTHERN CALIFORNIA SHELF

M. James Allen. ECORP Consulting, Inc.

This study describes soft-bottom fish community organization at 10–200m depths on the Southern California shelf. Organization is based on resource-partitioning among coexisting fish species, from 342 otter trawl samples at 99 stations in 1972–1973. The 126 fish species represented 43 families, dominated by pleuronectiform and scorpaeniform fishes.At affinity level 0.50, recurrent group analysis identified 34 species (27% of total) as important community members. Nine recurrent groups with 2 to 7 species per group, and 7 closely associated non-group species were described. Each recurrent group occurred in one of 3 major shelf depth zones.Coexisting recurrent group species were morphologically different, with morphologically similar species occurring in different groups at different depths. These species forage in different ways and on different types of prey. Diet and morphology of the 40 most common species

provided foraging behavior information for each species. From this, species were classified into 15 major foraging guilds. Equal-sized guild members are generally found at different depths. Depth replacement graphs for species in each guild showed regions of overlap where replacing species coexist, and include from two to four replacing species across the shelf. Depth-replacement graphs guilds were arranged to describe the functional structure and species composition of the communities. Community structure is described as the number and type of foraging guilds found at a given depth: species composition in terms of which species of each guild dominates at that depth. This community description provides a framework for determining natural or human factors that affect community organization.

4. EXPLORING THE ROLE OF SEAFOOD ADVISORY PROGRAMS AND SCIENCE IN CONSUMER BEHAVIOR MODIFICATION

D.L. Anderson. Seafood for the Future, Aquarium of the Pacific, Long Beach, 90802.

In this talk, we'll discuss the roles adopted by various environmental groups and the effects groups have, intended or unintended, on consumer behavior. A closely related topic is whether the public's increasing reliance on environmental NGOs for scientific information related to a widening gap between science education and the scientific community.

What is the best way for the seafood advisory industry to serve the public? Are seafood advisory groups meeting their goals, and how do they measure success? While there is no shortage of environmental groups who offer a seafood wallet card or list of acceptable fish and shellfish to consume, few data exist to determine the effect programs have in the marketplace or on the health of fish stocks they presume to protect. How can this data be collected and used to determine the efficacy of the seafood advisory industry?

5. THE EFFECT OF *GINKO BILOBA* ON THE MOUSE HIPPOCAMPUS

Alexa Aranjo. Chadwick School, 26800 South Academy Drive, Palos Verdes Peninsula, CA 90274. University of Southern California, Department of Biological Sciences, Neurology and Biomedical Engineering, Los Angeles, CA 90089.

Ginkgo biloba leaf extracts have been used for nearly 5,000 years to treat asthma and bronchitis and more recently, to enhance memory and concentration. Full mouse brain homogenates were treated with different concentrations of a flavone glycoside supplement. The sample's concentrations of cytoskeletal proteins actin and spectrin were found by Western blotting. Similarly, acute hippocampal slices were treated in varying amounts of the supplement, and actin and spectrin concentrations were determined via Western blotting. Cultured hippocampal neurons were treated with the supplement for varying amounts of times to see the effects within individual neurons; no significant increase of activity was noted. Four CAFI mice were fed a *Ginko biloba*-supplemented diet, and an immunohistochemistry was performed. The results of the Western blots showed that increased concentrations of *Ginkgo biloba* lead to higher concentrations of actin. Increased amounts of cytoskeletal proteins are indicative of enhanced synaptic plasticity.

6. A STUDY INVESTIGATING THE EFFECTS OF VARIOUS AMOUNTS OF SLEEP IN HIGH SCHOOL STUDENTS

Sagarika Arogyaswamy. Redlands East Valley High School – Dr. Larry Beeson – Loma Linda University.

Sleep has many functions, including keeping cognitive skills high. Many high school students nowadays do not have a sufficient amount of sleep. Although there is considerable research which shows that this negatively affects their academic performance, there is also research showing it has no effects. This study explores both the quantity and quality of sleep and the effects it has on academic performance. It controls for variables such as health issues, parental involvement, and active and sedentary lifestyles. Additionally this study looks to see classes being taken, time spent on homework, and other activities being done. While exploring academic performance, quantity of sleep, and quality of sleep, this study also looks at life

satisfaction. This allows us to see if happier students have more sleep and answers many other important questions. Life satisfaction is measured using a widely accepted scale. A survey is being administered to high school students in southern California in grades 9 and 10. The purpose of this survey is to add more research to this important field and observe if there really are effects present in lack of sleep at this period in one's life.

7. EFFECT OF ESTROGEN SUPPLEMENTATION ON THE SUSCEPTIBILITY OF MALE C57BL/6 MICE TO *CANDIDA ALBICANS* INFECTION

Melissa Arroyo-Mendoza and Nancy E. Buckley. California Polytechnic University, Pomona, Department of Biology, Pomona, CA, 91678.

Candida albicans (*C. albicans*) is the fourth most common pathogen found in blood cultures from hospital patients. In recent studies in our laboratory we have found that male c57BL/6 mice are more susceptible to a systemic *C. albicans* infections than female mice. Estrogen has been known to increase immune resistance to infection. Interestingly, estrogen receptors are found on certain immune cells including T cells, monocytes, and macrophages, suggesting that estrogen may enhance immune function by binding to these receptors. We have proceeded to investigate whether estrogen has a role in the resistance of female mice to this infection. We have treated male mice with estrogen to try to strengthen their immunity. Thus, c57BL/6 female or male mice (n=7) 8 weeks or age were treated as follows: (1) female mice sham implanted; (2) male mice sham implanted; (3–6) males implanted with 0.05, 0.1, 0.25 and 0.5 mg/21 day release β-Estradiol 17-Acetate pellet, respectively. Mice were then infected with 5.5 × 105 *C. albicans*/mouse (i.v.) and observed daily for morbidity and survival. We found that the different estrogen concentrations used did not improve the survival of the male mice. We analyzed serum of implanted males to compare to the levels found in females. We found that the serum from male mice implanted with the estrogen pellets had higher levels of estrogen than the females. It is known that when women are pregnant they have high estrogen serum levels and that these women are immunodefficent. Thus, we propose that we increase the estrogen levels to immune suppressive levels. Furthermore, we are investigating whether the serum cytokine profile is similar in female and male mice systemically infected with the yeast. Our findings will help us elucidate whether serum estradiol or cytokine production are indeed involved in gender specific response to the systemic *C. albicans* infection in mice.

8. ENVIRONMENTALLY CONTROLLED BIOLOGICAL TANK SYSTEM FOR GROWING/ MAINTAINING HUMAN ORGANS IN VIVO

Andrew Barajas, **Nadia Sharif**, **Edvard Arutyunyan**, and Dr. Frank Smith. Cal Poly Pomona, Department of Electrical and Computer Engineering, Department of Biology, Pomona, CA, 91768.

Organic tissue research is becoming more and more important in current technology and medical research. In organ and tissue transplantation many lives are lost due to lack of donations or low positions on waiting lists for sensitive and vital organs. In Bio-computing research there is a need for large amounts of organic tissue to explore the use of organic parts in electronic computer architecture, especially for applications involving organic-computer interfacing. In stem cell research providing nutrition to cell line creations using hands-on techniques are subject to human error, which can lead to infection and the eventual destruction of the cell line itself. Being able to produce organic tissues in large amounts using automated techniques would help advance current biomedical research and the medical field. Using an automated bioreactor system, we circulated large amounts of treated medium in order to simulate the internal environment of the human body so that large arrays of tissue can be grown for long periods of time. Lab View was used to monitor the pH, PPM, and temperature of the medium, provide automatic adjustment for pH and temperature, and provide sterilization and aeration of the medium. After successful calibration we were able to maintain a stable artificial environment for cellular tissue growth without medium degradation for up to six days without contamination. Based on medium cultures and environmental medium data, we concluded that this method could successfully maintain a viable environment for large-array tissue growing for weeks if not longer without compromising the cellular tissue itself.

9. ANALYTICAL SOLUTION OF PRESSURE-VOLUME EQUATIONS INDICATE CENTRALITY OF OSMOTIC POTENTIAL IN DROUGHT TOLERANCE AND NO ROLE OF SCLEROPHYLLY IN WATER RELATIONS

Megan Bartlett, Christine Scoffoni, and Lawren Sack. University of California Los Angeles, Department of Ecology and Evolution, Los Angeles, California, 90025.

Turgor loss point (π_{tlp}), the water potential below which plants experience irreversible wilting damage, is a significant determinant of plant drought tolerance and, therefore, species distributions relative to water availability. Understanding how variation in other drought tolerance traits determines π_{tlp} will therefore elucidate the ecological significance of these traits in species distributions, and resolve several long-standing controversies concerning drought tolerance mechanisms in ecosystems and agriculture. We present the first analytical solution, to our knowledge, of the fundamental pressure-volume curve equations, allowing the expression of π_{tlp} as a function of bulk modulus of elasticity (ε), apoplastic fraction (a_f), and osmotic potential (π_o). This model fit observed π_{tlp} from a meta-analysis of drought tolerance data extremely well ($r^2 = 0.99$; 89 species). Multiple global and local sensitivity analyses showed that π_o is the most important determinant of π_{tlp} across species, and the primary driver of drought acclimation within given species. Sclerophylly actually works contrary to π_{tlp} adjustment for drought tolerance, while shifts in ε and a_f have negligible direct impacts on π_{tlp}. Our meta-analysis also showed the importance of π_{tlp} and π_o as predictors of drought tolerance and species' distributions within and across biomes, and compared them to leaf mass per area, which is commonly used as a key functional trait for this purpose. This work will allow easier assessment of species' drought tolerance and resolution of the underlying mechanisms, which is of great importance in characterizing ecosystem and agricultural resilience to drought in a changing climate regime.

10. JUVENILE GROWTH OF A POPULATION OF SOUTHERN CALIFORNIA STEELHEAD (*ONCORHYNCHUS MYKISS*)

E. Bell[1], S.M. Albers[2], **J.M. Krug**[2], and **R. Dagit**[2]. [1]Stillwater Sciences, Arcata, CA, 95521; [2]Resource Conservation District of the Santa Monica Mountains, Agoura Hills, CA 91376-0638.

The life history of *Oncorhynchus mykiss* populations in the southern portion of their range has previously received less attention than in the Pacific Northwest. Here we examined size-at-age data collected from *O. mykiss* in Topanga Creek, Los Angeles County, California, where research has been conducted for nearly a decade. Our results suggest that all age classes of resident and anadromous *O. mykiss* in Topanga Creek grow year-round despite high summer water temperatures. Mark-recapture data showed that annual growth of *O. mykiss* in Topanga Creek ranged from 32–86 mm/year, and winter growth (November to March) averaged 0.4 mm/day. Young fish grew faster (~70 mm/year) than older (i.e. age 2–3) fish (~12 mm/year). In addition, age 2 *O. mykiss* smolts attain a size that has been associated with high (>10%) marine survival in other studies. Further studies documenting seasonal growth patterns and smolt sizes of *O. mykiss* in Topanga Creek are in progress.

11. HIGHLY MIGRATORY SPECIES FISHING LOGBOOK DATA: WHO, WHAT, WHEN, WHERE, WHY & HOW?

Amy Betcher. National Marine Fisheries Service, Southwest Fisheries Science Center, Fisheries Resources Division, 8604 La Jolla Shores Drive, La Jolla, CA, 92037.

Since the inception of the Highly Migratory Species Fisheries Management Plan (HMS FMP) in April 2005, HMS permit holders are required by law to submit their fishing logbooks for all trips targeting highly migratory species. The U.S. commercial and recreational fisheries that target HMS are classified by the gear used. Logbooks specific to each fishery are used to record data such as vessel information, daily fishing location and activity, gear usage, catch/discards, bycatch, and unloading information. Harpoon, Drift Gillnet, Pelagic Longline, Troll and Bait, Purse Seine and Commercial Passenger Fishing Vessel (CPFV) logbooks are received at the Southwest Fisheries Science Center within thirty days from the end of a fishing trip. The data collected from these logbooks are confidential and processed accordingly. The data

is edited, entered and summarized to fulfill ad hoc requests, reports, and data submissions. The data products are provided to scientists, stock assessment scientists, Regional Fishery Management Councils, Regional Fishery Management Organizations, NOAA headquarters, and the fishing industry. The data obtained from these logbooks are an important component in support of fishery management for sustainable fisheries.

12. EVALUATING RESTORATION PLANTING REGIMES IN A NEWLY RESTORED SOUTHERN CALIFORNIA SALT MARSH

E.M. Blair, C.R. Whitcraft, and B.J. Allen. California State University, Long Beach, Department of Biology, Long Beach, California 90840.

Salt marshes are one of the most productive ecosystems in the coastal zone with functions ranging from erosion reduction and storm surge buffering to toxin filtration and fish nursery provision. Plant cover within the marsh not only ameliorates harsh abiotic conditions but also serves as a nesting habitat for endangered bird species endemic to the area. In this study, we planted poly-culture treatments (which included nine common marsh species) and mono-culture treatments (all *Sarcocornia pacifica*, pickleweed) in a randomized block design to evaluate the effectiveness and recovery trajectory of active restoration in an unvegetated berm within Brookhurst Marsh, Huntington Beach, California. Throughout the study, *S. pacifica* has had the highest plant cover of the two treatments, but almost all plots, regardless of treatment, reached 100% cover after one year. The benthic invertebrate community shifted from virtually nothing pre-planting to an amphipod-dominated community after five months. This remains constant a year and a half after planting with no differences among treatments in either diversity or abundance. Benthic algae were absent pre-planting, rapidly increased during the first two months with the abundant light present, and have levelled off. Evaluating how plant community composition drives community trajectory and assessing the most successful planting regime in terms of plant cover and algal and invertebrate abundance has implications for future restoration planning and the regeneration of endemic bird nesting habitat.

13. FIRE RESPONSES OF SOUTHERN CALIFORNIA WALNUTS AND THEIR WOODLANDS

Edward G. Bobich, Frank W. Ewers, Yasuhiro Utsumi, and Dustin M. Ray. California State Polytechnic University, Pomona, Biological Sciences, Pomona, CA 91768.

Southern California black walnut (*Juglans californica*) is native to a wide variety of habitats, including lower chaparral, coastal sage scrub and riparian evironments. Due to urbanization and the accompanying flood control in Southern California, most of the native walnut habitat has been lost or altered. In inland valleys, the majority of the remaining walnuts occur in woodlands where they are the dominant trees, or are codominants with coast live oak (*Quercus agrifolia*). Like most of the communities in the region, these woodlands are frequently subjected to fire. The walnuts themselves appear to recover quickly from fire, forming large shrubs with sometimes hundreds of sprouted stems within weeks of death to their aboveground organs. Resprouting is facilitated by the presence of large, below-ground lignotubers and what is believed to be an extensive root system with substantial carbohydrate reserves. The resprouted plants themselves are less water-stressed, have higher photosynthetic rates, and are less-susceptible to xylem cavitation compared to unburned adults. Although walnuts appear to recover from fire quickly, the woodlands are likely more susceptible to fire now than ever before in their history, primarily because the understory vegetation is dominated by large, exotic annuals that build up a great deal of litter in a short time. The greater susceptibility of these environments to fire and the increasing presence of exotics may alter the physical structure of the walnuts and eventually lead to the decimation of walnut populations in inland valleys.

14. PERCHING PREFERENCES OF RAPTORS IN THREE SOUTHERN CALIFORNIA SALT MARSHES

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The presence of raptor species may negatively affect the recovery of special status avian species populations in southern Californian salt marshes. This study investigates the environmental and biological factors influencing red-tailed hawk (*Buteo jamaicensis*), osprey (*Pandeon halieatus*) and American kestrel (*Falco sparverius*) perching preferences in order to better inform raptor management within the Los Cerritos Wetlands, Seal Beach National Wildlife Refuge and Bolsa Chica Ecological Reserves. Perching geography and frequency were mapped using GIS and analyzed in relation to adjacent habitats types and perch substrates. Results indicate that anthropogenic perches and certain habitat types, primarily roads and waterways, are vital components to raptor life in humanized salt marshes.

15. RARE EARTH MINERALIZATION OF SOUTHERN CLARK COUNTY, NEVADA

Jessica J. Bruns and David R. Jessey. California State Polytechnic University-Pomona, Geological Sciences Department, Pomona, CA, 91768.

Rare earth mineralization was first reported in the New York Mountains of southern Nevada and eastern California by Volborth (1962), 30 kilometers to the east of the rare earth carbonatite complex at Mountain Pass, California. Our research examines the northern portion of this mineralized trend lying within southern Clark County, Nevada. The New York Mountains are comprised of orthogneissic granitoids emplaced in a north-south-trending zone at about 1.65 to 1.80 Ga (Miller and Wooden, 1994). Greenschist to amphibolite grade metamorphism overlapped batholitic emplacement. XRF whole rock analyses indicate the host rocks are predominantly silica-oversaturated granite to quartz monzonite. However, field observations suggest a period of silica flooding coincident with metamorphism or hydrothermal alteration with the original protolith composition most likely monzonite to syenite. Mineralization occurs in pods, dikes and veins along a 2.5 kilometer trend striking N20°E, informally termed the "Lopez Trend". Controls for mineralization are enigmatic. Numerous northeast-striking faults have been mapped throughout the northern New York Mountains, but mineralized outcrops lack slickensides or any evidence of lithologic discontinuity. In addition, most dikes closely parallel regional foliation. XRF, XRD and thin section analyses reveal that mineralization occurs predominantly as rare earth fluor-apatite with lesser monazite. A few grains of epidote (var. allanite) were observed in hand sample. Locally some dikes report high concentrations of Na2O (>10%). These were examined and found to be comprised almost exclusively of albite, suggesting the mineralizing event was related to emplacement of albitite dikes (Na-metasomatism). A strikingly similar series of rare earth-bearing dikes have been described on the island of Sardinia (Palomba, 2001). There, mineralization is ascribed to a metasomatic event occurring during the latter stages of rifting. As the nearby Mountain Pass carbonatite complex is thought to be related to a 1.3–1.4 Ga rifting event, it seems plausible that the rare earth mineralization of the northern New York Mountains may represent a distal phase emplaced along permeable zones in the gneissic complex by circulating metasomatic fluids.

16. CHANGE IN WATERBIRD POPULATION AT THE SOUTH SALTON SEA VARIES WITH BIRD SPECIES BEHAVIOR RATHER THAN INFLUENCED BY ENVIRONMENTAL CHANGES.

A. Bui and L. Wu. Cal Poly Pomona, Department of Biological Sciences and Department of Geography and Anthropology, Pomona, CA, 91768.

Ever since its inundation in 1905, the Salton Sea of California has become a unique component of the desert ecosystem in the Imperial Valley, and a main concern of many environmentalists. While the Salton Sea has inevitably grown to be the sink of agricultural runoff in the Imperial Valley, it is a major source for many surrounding flora and fauna. Its saline water, resulted from evaporation, attracts large populations of migratory waterbirds. However, as the water level decreases due to recent conservation water projects, and salinity increases, waterbird populations are put at risk because of high level of agricultural-related contaminants. Thus, it is imperative to see how the waterbird populations have changed over time. This study explores the bird population change over time based on Christmas bird count of the South Salton Sea from the Audubon Society, along with other environmental elements such as precipitation, temperature from meteorology stations, water level and salinity from the Imperial Irrigation District. Data with time sequence were charted and analyzed with descriptive statistics. Spatial visual analysis were also

performed based on satellite images using GIS mapping and image processing functions. The results from this study show that the change in bird population varies with bird species and is associated more with independent bird behaviors than environmental changes observed during the study period.

17. SOUTHERN CALIFORNIA STEELHEAD RECOVERY AND CLIMATE CHANGE

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The National Marine Fisheries Services listed two distinct sub-populations (DPS) of steelhead trout (Oncorhynchus mykiss) within the southern half of coastal California in 1997 and 2002: a threatened sub-population along the south-central coast and an endangered sub-population along the south coast to the U.S.-Mexico border.

Steelhead populations were once widely distributed throughout California. Steelhead populations in watersheds draining the higher mountain ranges benefited from stream flows sustained by snowmelt which helped maintain cool water temperatures during the summer low-flow season, and generally tended to moderate flows year round,

In contrast, steelhead populations along the California coast between Monterey Bay and the US-Mexico border persist in fire-dependent chaparral forests (with the exception coast redwoods along the Big Sur Coast). The inland basins are relatively few, large, and have a terrestrial climate; whereas coastal basins tend to be small, numerous, and have a heavily marine-influenced climate, with coastal fog common in the summer months.

The Recovery Plans for the South-Central and California Steelhead DPSs identifies recovery actions intended to address a wide variety of threats currently facing the species, as well as future threats posed by projected climate changes. Steelhead at the southern end of their range have persisted in watersheds that have exhibited a wide range of habitat conditions over the past 20,000 years, and have evolved a comparable variety of life-history strategies (and other adaptations) to cope with highly variable, and sometimes hostile environmental conditions. These life-history strategies have pre-adapted this species to climate driven erratic and unstable habitat conditions, including some of those which climate change models predict. However, anthropogenic changes to the coastal watersheds used by south-central and southern California steelhead for their freshwater reproductive life-history phase exacerbate threats to these two federally listed species.

18. SEASONAL NIGHTTIME TRANSPIRATION IN ADULTS AND RESPROUTS OF SOUTHERN CALIFORNIA BLACK WALNUT AND COAST LIVE OAK

M.A. Caringella, E.G. Bobich, and F.W. Ewers. California State Polytechnic University, Department of Biological Sciences, Pomona, CA, 91768.

Nighttime transpiration has been reported in many species, but the seasonal patterns, which may provide insight as to the mechanisms and function, have been little studied. We examined day and nighttime transpiration in two species with differing leaf habit, the deciduous southern California black walnut (*Juglans californica*) and evergreen coast live oak (*Quercus agrifolia*). For each species two growth forms were examined, adults and 2-year post-fire basal resprouts. Daytime (12pm–4pm) and nighttime (12am–4am) stomatal conductance was measured in order to determine if nighttime transpiration was occurring, and to compare the levels of occurrence between species and growth forms. Results showed consistent nighttime stomatal conductance for both species, although at a greater percentage of the daytime rate in *Q. agrifolia*. Mean day and nighttime stomatal conductance were also significantly higher in *Q. agrifolia* (day 89.5 mmol $m^{-2}s^{-1}$; night 53.5 mmol $m^{-2}s^{-1}$) as compared to *J. californica* (day 49.3 mmol $m^{-2}s^{-1}$; night 22.4 mmol $m^{-2}s^{-1}$). Within both species the resprouts had greater mean day and nighttime stomatal conductance as compared to the adults. Day and nighttime water potential measurements showed a slight increase in stomatal conductance as leaf water potential increased across both species and growth forms. No correlation was shown between stomatal conductance and percent relative humidity. The level of nighttime stomatal conductance in *Q. agrifolia* suggests an unseen benefit to nighttime transpiration in this species that outweighs the cost of transpirational water loss even in a water-limited Mediterranean-type climate.

19. DOES EMBRYONIC INCUBATION TIME AFFECT MORPHOLOGY AND FEEDING ACTIVITY OF CALIFORNIA GRUNION LARVAE?

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The California grunion, *Leuresthes tenuis*, spawns on sandy beaches on nights following the spring high tides. Fertilized eggs develop within the sand for 8–14 days until they are stimulated to hatch by wave action during the next spring high tide. If that does not happen, embryos can extend incubation to up to 30 days post-fertilization (dpf) and hatch during a subsequent spring high tide. We investigated the effects of extended incubation on skeletal morphology and feeding activity in California grunion larvae. We tested the hypotheses that 28-dpf larvae (extended incubation) would have more skeletal structures in the jaws and caudal fin and have greater feeding rates than 10-dpf larvae (normal incubation). Seven batches of fertilized eggs were incubated at 20°C and groups of embryos were randomly selected to be stimulated to hatch at 10 or 28 dpf. Feeding rates of 10-dpf and 28-dpf larvae were measured as the change in rotifer density over a 4-h period. Of those larvae, 30 individuals per batch were cleared and stained to observe skeletal structures. The number and lengths of the skeletal elements in the caudal fin were measured and the numbers of dentary and pharyngeal teeth were counted. The 28-dpf larvae had significantly more dentary and pharyngeal teeth, more and larger skeletal elements in the caudal fin and significantly greater feeding rates than 10-dpf larvae. Thus, extended incubation in *L. tenuis* results in larvae that have more developed skeletal structures and consume rotifers at greater rates, which may consequently improve larval survival.

20. FLOWER PREFERENCE AND VISIT DURATION OF EUROPEAN HONEY BEES ON SEEDLESS WATERMELON

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The European honey bee (*Apis mellifera*) has long been considered the most important agricultural pollinator. Much attention is being paid to honey bees in light of recent, dramatic population declines due to Colony Collapse Disorder. Previous pollination research on the monoecious watermelon plant (*Citrullus lanatus*) suggested foraging behavior differed among individuals based on whether they carried clumps of pollen on their hind tibiae or not. We hypothesized that pollen-carrying bees would have a greater affinity for staminate flowers, while bees without pollen would prefer pistillate flowers.

Honey bees were categorized as either pollen or nectar foragers. Data on visitation to watermelon flowers were recorded, including the sex of the visited flower and the duration of the visit, which was used as an indication of preference. The sex ratio of flowers visited by individual bees was also recorded, as well as the sex ratio of flowers in the field.

Our results indicate that honey bees do not seek out specific sexes of flowers. However, nectar foragers spent significantly longer periods of time foraging on pistillate flowers, which offer more abundant and easily accessible nectar. Pollen-producing staminate flowers received longer visits from pollen foragers. Longer visits on pistillate flowers by bees not specifically foraging for pollen may serve to increase stigmatic pollen deposition. There was also an observed dichotomy in terms of average visit durations on unvisited, "virgin" pistillate flowers (30 seconds) and previously visited flowers (6 seconds). This discrimination may be due to the untapped nectar resources in virgin pistillate flowers.

21. THE RESURRECTION OF *GALEORHINUS ZYOPTERUS* IN THE NORTHEASTERN PACIFIC AND ITS GLOBAL CONGENERICS BASED ON GENETIC, LIFE-HISTORY, AND MORPHOLOGICAL EVIDENCE

C.L. Chabot. University of California, Los Angeles, Department of Ecology and Evolutionary Biology, Los Angeles, CA, 90095.

The soupfin shark, *Galeorhinus galeus,* is a commercially important member of the Triakidae that has suffered a long history of global exploitation resulting in historic population collapses. In order to

effectively manage and conserve populations of *G. galeus*, it is important to determine the levels of connectivity among globally distributed populations and assess the taxonomic status of the species. Thirteen polymorphic microsatellite loci were used to determine the population connectivity of geographically isolated populations of *G. galeus* from Africa, Australia, North America, South America, and Western Europe. Genetic analyses revealed significant structure among all populations indicating a lack of gene flow and evidence of a genetic bottleneck in the northeastern Pacific. These findings indicate that globally distributed populations of *G. galeus* are isolated and should be managed as distinct, independent stocks. Furthermore, the observation of private microsatellite alleles, unique region-specific mitochondrial haplotypes, and regional differences in morphology and life-history suggest that a resurrection of *Galeorhinus zyopterus* in the northeastern Pacific as well as the resurrection of its global congenerics may be warranted.

22. THE USE OF NEXT-GENERATION SEQUENCING TO DISCOVER MICROSATELLITE LOCI FOR NORTHEASTERN PACIFIC TRIAKID SHARKS

C.L. Chabot and S. Nigenda. University of California, Los Angeles, Department of Ecology and Evolutionary Biology, Los Angeles, CA, 90095.

Using population genetic methods to estimate population connectivity is important for the conservation of exploited elasmobranch species. One such elasmobranch, the soupfin shark, *Galeorhinus galeus* (Triakidae), has been exploited for >80 years and has suffered population declines historically. Here we describe the discovery of microsatellite loci for *G. galeus* by next-generation sequencing (Roche 454 pyrosequencing) and their utility for eastern Pacific smooth-hound sharks (*Mustelus*). Next-generation sequencing generated ~40,000 sequences, of which, 256 putative microsatellite loci were identified consisting of di, tri, tetra, and pentanucleotide repeats. Similar to other species of shark, dinucleotide repeats were the most commonly observed motif in *G. galeus*. Thirty-two loci were screened for *G. galeus* resulting in a total of 13 polymorphic loci (3–12 alleles) with observed heterozygosities between 0.11 and 0.86 and expected heterozygosities between 0.24 and 0.87. All loci were in Hardy-Weinberg equilibrium with the exception of two loci and all were in linkage equilibrium. Of the 13 loci, seven positively amplified for *Mustelus californicus and M. henlei* from the northeastern Pacific.

23. USING MAPS OF THE EXTENT OF NEARSHORE ROCKY REEFS IN SANTA MONICA BAY TO ESTIMATE THE ABUNDANCE AND REPRODUCTION POTENTIAL OF IMPORTANT FISHERY SPECIES

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Multiple spatial datasets, aerial and satellite photography, underwater field observations and expert judgment were used to produce fine scale maps of the extent of nearshore subtidal rocky reef habitat (<30 m depth) in Santa Monica Bay. Kelp Bass (*Paralabrax clathratus*) and California Sheephead (*Semicossyphus pulcher*), two economically and ecologically valuable rocky reef fishes, were then used as case studies to examine the contribution of each reef to regional estimates of standing stock and reproductive potential. Abundance and size structure data were extracted from a total of 621 fish transects that were completed from 2007 through 2009 across 18 of the 22 reefs in the region. These data were combined with reproductive parameters from the literature to estimate annual egg production for each adult individual observed. Depth zone exhibited a clear effect on the abundance per transect of both species. Therefore, the proportion of each reef in each depth zone was estimated and used, following a depth stratified sampling approach, to calculate mean density, total numerical abundance and annual egg production potential across each reef and for the region as a whole. Estimates of reef area proved useful in providing additional value to estimates of fish density, allowing for greater insight into the value of specific reefs from a regional scale perspective and may help target fisheries management and habitat restoration efforts.

24. A CLOSER LOOK AT EXCITATION-EMISSION MATRICES AND DATA ANALYSIS

Dr. Timothy Corcoran, ScREEM Research Group Co-Authors: Christopher M. Dettmar, Jacob B. Balthazor, Phillip G. Allen, Jose L. Chavez, Ivonne P. de la Torre, **Alisha J. Lewis**, Neda F. Nouri Nassr, and Hossein Ahmadzadeh. Hossein Ahmadzadeh.

The ScREEM research group works on developing, imaging, machinery, and analytical techniques. ScREEM stands for super-continuum rapid excitation emission matrix. The ScREEM research group uses a design that focuses a super-continuum laser beam onto a capillary in which the selected sample flows through. The solution fluoresces at its respective wavelength and a measurable excitation emission matrix (EEM) is generated. We have created a way to generate this in a program called LabView. Our program in LabView, has a very unique and useful design because many of the leading excitation-emission matrix machinery take anywhere from minutes to hours to produce the same results that we obtain in fractions of a second.

Programs such as MATLAB and LabView were created as a step by step approach in analyzing the results from our experiments. Each of these programs are a piece of a puzzle that ultimately minimize the Mie scatter that we see within our samples. One of the most important things that we have been trying to do throughout our research is to accurately collect a Rayleigh data file. All of these programs have been collected and strung together to create an ultimate program that instantaneously does all of these smaller programs. This program was created in order to use an automatic and systematic approach to understanding our research. Because of this, we are able to reproduce exact results whenever we would need to rerun a sample.

25. ROCKS AND BOATS: WHY THE TRANSATLANTIC MIGRATION ROUTE CANNOT STAY AFLOAT

Greg Corcoran. Department of Anthropology, California State University at Fullerton, 92834.

Debate over how the first American reached North America is still a hot topic in American archaeology. This paper will give a background on the different migration routes into the New World and follow up with evidence from linguistic, genetic, and dentition. Specific attention will be given to the transatlantic migration route in regards to the possibility of a Clovis and Solutrean connection. Evidence from lithic analysis of the organization of lithic technology of the two complexes will show if there is a connection between these two cultures. This in conjunction with the other forms of evidence will help to disprove the transatlantic migration route.

26. FEMALE BODY SIZE AND REPRODUCTIVE OUTPUT IN THE GREEN LYNX SPIDER *PEUCETIA VIRIDANS* (ARANEAE, OXYOPIDAE)

Sophie Crinion and Martin G. Ramirez. Loyola Marymount University, Department of Biology, Los Angeles, CA, 90045.

In this study, I sought to determine the relationship between female size and various measures of reproductive output in the green lynx spider *Peucetia viridans*. A total of 59 *P. viridans* females were collected with their egg sacs from Kenneth Hahn Recreation Area between October 2010 and January 2011. Female size [carapace width (mm)], female weight (mg), and the following egg sac parameters were recorded: egg sac mass (mg), silk mass (mg), egg mass (mg), and number of eggs. These measures were used to calculate the average egg weight; the egg sac mass per offspring; the residual index (a measure of female body condition); and the relative clutch mass (an indicator of female reproductive effort). Female size and weight were positively correlated with egg sac mass, silk mass, egg mass and number of eggs. In contrast, average egg weight and egg sac mass per offspring were not significantly influenced by any of the above factors, suggesting that *P. viridans* has an optimum egg sac mass per egg and average egg mass. These results are consistent with the findings of Killebrew & Ford (1985). However, relative clutch mass was positively correlated with all the fecundity measures, including average egg weight, suggesting that egg weight is not always fixed. This indicates that females who invest more energy into reproduction can produce heavier eggs.

27. RESTORATION OF OLYMPIA OYSTERS IN NEWPORT BAY: OYSTER SETTLEMENT, RECRUITMENT, AND COMMUNITY BIODIVERSITY ON CONSTRUCTED OYSTER BEDS

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The Olympia oyster has experienced substantial population declines throughout its range (Sitka, AK to Baja California, Mexico) since the early 1900's. Our study is testing the effectiveness of different restoration techniques for this species in southern California. We hypothesized that Olympia oyster larvae will settle and recruit more and that epifaunal community diversity will be higher on a thick, consolidated oyster bed compared to a thin, unconsolidated bed or to a mudflat and that infaunal diversity will be lower under an oyster bed than a mudflat. We also hypothesized that oyster bed attrition would be greater in thin, unconsolidated versus thick, consolidated treatments. To test our hypotheses, we augmented intertidal mudflat with *Crassostrea gigas* shell into replicate (n=5) 2 m × 2 m plots of two thicknesses, 4 cm and 12 cm, and two types, bagged/consolidated shell vs. loose shell, plus 5 control plots without shell added (total=25 plots). We then monitored oyster settlement, recruitment, and bed attrition on each plot. Larval settlement was not significantly different among plots. After 6 months, the density of Olympia oysters was significantly higher on treatment plots versus control plots, but bed thickness and consolidation did not affect oyster density. However, the 12 cm-thick oyster beds experienced significantly less shell attrition than 4 cm beds. We are currently assessing changes in epifaunal and infaunal biodiversity as a function of treatment. The results of this study will contribute to the design of future oyster restoration efforts in southern California.

28. ADAPTIVE MANAGEMENT OF ESTUARINE WETLANDS IN SAN DIEGO

J.A. Crooks[1], M. Cordrey[1], H. Bellringer[1], and K. Uyeda[1,2]. [1]Tijuana River National Estuarine Research Reserve; [2]San Diego State University.

A central problem in trying to understand, protect, and restore natural ecosystems is the realization that many changes in these areas tend to go unnoticed. This results in the phenomenon of "shifting baselines," where we progressively lower our expectations of what to expect from nature. One way to counter this is to learn as much as we can about ecosystems of the past, including examining the historical ecology of coastal wetlands. Implementing long-term monitoring also helps counteract the shifting of baselines, and a program that tracks short-term variability and long-term change in both physical and biological properties has been implemented in the Tijuana River National Estuarine Research Reserve, South San Diego Bay, and Los Penasquitos Lagoon. This monitoring also provides direct links to management activities, such as the mechanical opening of lagoon mouths after closure. Data such as these help improve our understanding of coastal systems, as well as improve the ability to effectively manage and restore such areas.

29. THE PACIFIC FISHERIES INFORMATION NETWORK (PACFIN): THE DEVELOPMENT OF THE NATION'S FIRST REGIONAL FISHERIES DATA NETWORK

Craig D'Angelo. National Marine Fisheries Service, Southwest Region, Sustainable Fisheries Division, Long Beach, CA, 90802.

Effective fisheries management requires accurate and timely knowledge of commercial fishing activity. A significant source for that information is landings data. When a fisherman sells his or her product, the transaction is recorded on a fish ticket. This ticket is then inputted into a database managed by the state agency in which the landing took place. However, to manage federal fisheries that often span state boundaries, state landings data needs to be aggregated into one regional dataset. The Pacific Fisheries Information Network (PacFIN) is the nation's first regional fisheries data network. Established in 1981, PacFIN is a joint federal and state project focused on fisheries data collection and information management. Since its inception, PacFIN has adapted to meet the needs of Biologists, Social Scientists, Law Enforcement

and Fisheries Managers. It currently receives regular data feeds from the states of Washington, Oregon, and California, the Alaska Fishery Science Center, the National Marine Fisheries Service/ Northwest and Alaska regions, the U.S. Coast Guard and the Canadian Department of Fisheries and Oceans.

30. EFFECTS OF LOCAL WEATHER CONDITIONS ON BIRD SPECIES DETECTION IN A COASTAL SAGE SCRUB HABITAT

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Knowledge of how many and which bird species are utilizing an area contributes to an understanding of the ecology of that habitat. Awareness of factors which may have an effect on the detection of bird species is imperative in assessing avian species richness as well as in establishing the presence or absence of particular species. Environmental studies and assessments are of the utmost importance in severely impacted ecosystems such as California's coastal sage scrub. This is the primary habitat of many native California bird species, including the federally threatened Coastal California Gnatcatcher, *Polioptila californica californica*. This study aims to determine if local weather conditions influence the detection of bird species in a coastal sage scrub habitat by conducting a series of observational visits in the Voorhis Ecological Reserve. Local weather conditions may be a source of bias and error in assessing avian species richness, it is hoped that this project will lead to a correlation between the local weather conditions and the number of species detected, and recommendations to reduce such bias and error.

31. POTENTIAL DRIVERS OF MACROALGAL PREFERENCE IN SOUTHERN CALIFORNIA MARINE CONSUMERS

Allyson Degrassi and Jayson Smith. Cal. State University, Fullerton.

Marine macroalgal consumers are known to preferentially feed on certain seaweeds, possibly driven by a number of factors including co-evolutionary history, edibility, and nutrition. In southern California, previous two-choice experiments revealed that urchins (*Strongylocentrotus purpuratus*) preferentially consume the native kelp *Macrocystis pyrifera* over the morphologically and taxonomically similar non-native kelp *Undaria pinnatifida* while crabs (*Pachygrapsus crassipes*) exhibit the opposite pattern. This study was an initial attempt to examine potential factors affecting feeding choices using these species as models. We hypothesized that observed choices are a function of the consumers' ability to effectively consume, assimilate, and allocate energy from the macrophyte. After a 30-day diet of either kelp, consumers were expected to grow faster and assimilate more efficiently on their preferred diet. However, neither crab nor urchin assimilation differed on the two diets and only crabs grew faster on its preferred food. Consumer choice also was expected to be partially driven by algal characteristics, such as organic/ caloric content and tissue toughness. Nutritional quality was relatively similar in both species but the thinner *Undaria* blades were easier to tear and puncture. Our results suggest that crabs may prefer *Undaria* as it resulted in higher growth and may be easier to manipulate and consume. No clear drivers were discerned for urchins but, speculatively, may be attributed to the co-evolutionary relationship with *Macrocystis* in which it associates with, a relationship absent between crabs and kelp. Our results using a limited model suggest that mechanisms behind food choices likely differ among taxa.

32. IDENTIFICATION OF DIFFERENTIAL CDNA AFLPS IN MAIZE ENDOSPERM DEVELOPMENT

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Programmed cell death (PCD) is a genetically regulated process that occurs during maize endosperm development. A better understanding of this process may open the door to new strategies for the optimization of grain yield. This work focused on the identification of ESTs from cDNA populations, whose up or down regulation correlates with the timing of endosperm death. Total RNA was isolated from endosperm tissue harvested at 18, 20, 24, and 28 days after pollination (DAP), and cDNAs were generated from mRNA populations. Amplified fragment length polymorphisms (AFLPs) were generated with 9 primer

sets. This work identified 18 AFLPs, sizes between 500 and 1400 base pairs, which exhibited differential expression that correlates with endosperm PCD. Downstream research will include the isolation and sequencing of these partial cDNAs. In addition, fragments will be used to pull out full clones from a cDNA library for a more complete characterization of these genes in maize endosperm development.

33. TEMPERATURE AND LIGHT EFFECTS ON THE GERMINATION OF *SALICORNIA VIRGINICA*

Claire Dolphin, **Kathryn Carmody**, and Philippa M. Drennan. Loyola Marymount University, Department of Biology, Los Angeles, CA 90045.

Salicornia virginica is a dominant species in temperate coastal wetlands including the Ballona Wetlands of Los Angeles County. Temperature and light cues for germination position plants both spatially and temporally in favorable habitats and seasons for growth. The optimal requirements were investigated for *S. virginica*, which must establish in the fluctuating conditions associated with seasons and tidal action. From initial trials performed in the laboratory, it was determined that *S. virginica* germinated more rapidly in the light, although final percentages of germination were not significantly different between light and dark treatments. Germination did not occur in light or dark under constant temperatures. However, over 90% of the seeds germinated under alternating temperatures (15/35 °C). Temperature fluctuations in the substrate of the Ballona Wetlands were recorded throughout the year using micro-T temperature loggers. The amplitude of diurnal temperature differences was significantly smaller within dense growth of *S. virginica* (P=0.049) than at the population edge. The construction of a thermal gradient apparatus in the laboratory is being used to determine the amplitude of temperature fluctuation resulting in some germination as well as that maximizing germination of *S. virginica*. Temperature and light requirements suggest rapid germination in more open microenvironments.

34. EXPLORING COLLABORATIVE LANDSCAPE CONSERVATION OPPORTUNITIES IN SOUTHERN CALIFORNIA: NATIONAL PARK SERVICE SPECIAL RESOURCE STUDIES

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Throughout the nearly 100-year history of the agency, the National Park Service system has grown to include 394 national parks, monuments, battlefields, recreation areas and other designated units. Over time, these units have been added to the system through a variety of ways and for a variety of reasons. In the National Park System General Authorities Act of 1970, Congress declared that areas comprising the national park system are cumulative expressions of a single national heritage. As such, potential additions to the national park system should contribute in their own special way to a system that fully represents the broad spectrum of natural and cultural resources that characterize our nation. The 1998 National Parks Omnibus Management Act established a new process for identifying and authorizing studies of new units. From this legislation, the "Special Resource Study" process emerged, establishing specific criteria for evaluating and recommending new additions to the national park system.

In southern California, two special resource studies are currently underway including the San Gabriel Watershed and Mountains Special Resource Study and the Rim of the Valley Corridor Special Resource Study. Together, these studies are considering a regional-scale network of natural lands and open spaces to determine whether any portion of these study areas is eligible to be designated as a unit of the national park system or added to an existing national park. The study will also explore other ways that private or governmental entities can protect resources and provide more outdoor recreation opportunities.

35. SEASONAL CHANGES IN THE VESSEL ANATOMY OF ADULT AND RESPROUTS OF CALIFORNIA BLACK WALNUT TREES FOLLOWING WILDFIRE

D. Duarte, E.G. Bobich, S. Pak, S. Pham, Y. Utsumi, and F.W. Ewers. Department of Biological Sciences, California State Polytechnic University, Pomona, CA, 91768.

Following a wildfire at Bonelli Park in San Dimas, CA, unburned adult trees and new growth resprouts of Juglans californica S. Watson were examined to determine the anatomical basis for seasonal variation in hydraulic conductivity and mechanical flexibility and strength. Differences between growth forms were also considered. Stems from nine individuals per adult and resprout growth forms were sampled monthly from February through June of 2008. Stem samples were sectioned to analyze for variances in vessel diameter, hydraulic vessel diameter, vessel frequency, percent conductive, and percent vessel lumen area. The results showed a significantly greater vessel frequency in adults than in resprouts with a decrease of frequency through the season. In addition, the vessel lumen areas tended to be greater in adults, whereas the mean and hydraulic vessel diameters tended to be greater in resprouts. Both growth forms demonstrated positive increases in percent conductive, percent vessel lumen area, and hydraulic vessel diameter going from February through June. All the seasonal changes can be attributed to the production of a new xylem growth ring. The resprouts especially showed much larger mean and much larger hydraulic mean vessel diameters in the outer growth ring. In adults, vessel frequency and percent vessel lumen area were especially high in the outer growth ring. A separate study on these plants showed that hydraulic conductivity increased greatly between the months of April and May for adults and resprouts, likely related to the production of the outer growth ring. Overall differences between growth forms in vessel diameter and frequency were correlated to higher mechanical strength (lower vessel frequency and percent vessel lumen area) and higher hydraulic conductivity (greater hydraulic diameter) in resprouts than in adult trees.

36. RELATIONSHIP BETWEEN *CARPOBROTUS EDULIS* (AIZOACEAE) SURVIVORSHIP AND PATCH SHAPE

J. Duong, C. Kim, and V. Carmona-Galindo. Loyola Marymount University, Department of Biology, Los Angeles, CA 90045.

The iceplant (*Carpobrotus edulis*) is an exotic plant that has invaded chaparral habitats in Southern California (Schmalzer, 1987). The objective of our study was to evaluate the relationship between the shape of the area covered by an iceplant patch and the survivorship of the individuals that make up the patch. Our study was conducted along the bluff at Loyola Marymount University in Los Angeles, California. Iceplant cohorts (based on size) indicate a Type III survivorship curve. Survivorship correlated positively with a deviation from circular patch shape ($r = 0.99$, $p<0.05$). This suggests that the accumulation of longer (and presumably older) individuals contributes to a patch shape that will become less circular over time.

37. A COMMERCIAL FISHERMAN'S VIEWPOINT

Peter Dupuy. Commercial fisherman, Ventura, CA.

Pete Dupuy is a commercial fisherman from Ventura, CA and has been fishing for over 40 years. Currently, he sits on the Pacific Fishery Management Council's Highly Migratory Species Advisory Subpanel. Dupuy is the only pelagic longline fisherman on the west coast, and has caught a wide variety of fish, from squid to swordfish. In 2005, Dupuy started his own fish market at the Ventura Harbor. Over the years the market has grown in popularity and now serves thousands of customers once a month during the tuna season. The market provides fresh, sushi grade tuna at an affordable price directly to the public. In addition to selling to customers and wholesalers, Dupuy has also been instrumental in the Federation of Independent Seafood Harvesters' (FISH) effort to help conserve the leatherback sea turtle population. In 2004, Dupuy collected funds for the Mexican conservation group ASUPMATOMA. Their work included protecting the nesting sites of the leatherback turtle in Baja California, Mexico. In a period of three years, Dupuy and FISH collected over $200,000 to help sustain the conservation effort.

38. ELEVATED ENDEMISM IN THE NORTHERN GULF OF CALIFORNIA: SPECIATION AND PHYLOGEOGRAPHY OF THE ESTUARINE GOBY GENUS *GILLICHTHYS*

R.A. Ellingson and D.K. Jacobs. UCLA, Department of Ecology and Evolutionary Biology, Los Angeles, CA, 90095.

The longjaw mudsucker *Gillichthys mirabilis* inhabits muddy channels in estuaries from northern California to Baja California and into the Sea of Cortez (i.e. Gulf of California). Endemic to the northern Gulf, its congener *G. seta* is a denizen of high rocky shorelines and sandy tidal streams. It is thought that *G. seta* became isolated from *G. mirabilis* following formation of the Baja peninsula as a consequence of vicariance coupled with adaptation to the unique northern Gulf environment. However, divergence time estimates indicate *G. seta* may be older than the Gulf itself, suggesting speciation occurred prior to opening of the Gulf. A third member of the genus *Gillichthys*, recently resurrected to species status as *G. detrusus*, is also a northern Gulf endemic, but geographically restricted to the immediate delta region of the Colorado River. This localized species is younger than *G. seta* and adapted specifically to the massive estuarine system at the river mouth. In addition, a distinct mitochondrial lineage of *G. mirabilis* is also endemic to the northern Gulf. Taken together, these observations suggest that multiple factors throughout the Gulf's existence have contributed to endemism in the region. To provide insight into this complexity, evolution and speciation in *Gillichthys* spp. will be discussed in the context of tectonic history and ecological adaptation. Underscoring the importance of this work is the existence of additional marine taxa endemic to the northern Gulf, many of which are threatened by coastal development, overfishing and the elimination of fresh water input by dams upstream.

39. MODELING THE DYNAMICS OF DISTURBANCES IN MUSSEL BEDS

Melo-Jean Y. Encinas, Edgar Diaz, and Robert A. Desharnais. California State University, Los Angeles, Department of Biological Sciences, Los Angeles, CA.

Cellular automata (CA) models have been used to model the dynamics of disturbances in marine mussel beds, *Mytilus californianus*. These models usually consider transitions among a small number of states, for example, "empty," "occupied," and "disturbed", and assume a homogenous spatial environment without boundaries. On the other hand, more complex CA models have also been used to study mussel bed boundary formation. These models consider mussel settlement and growth and predator-prey dynamics within gradients of tidal height and wave exposure. We present results from a model that combines these approaches. Small "patches" of the mussel bed are modeled using a mean field ODE approximation to the complex CA model. Each patch represents an area of constant tidal height and wave exposure. Adjacent patches are linked through local interactions to form a "quilt" that spans gradients of tidal height wave exposure. Patches are vulnerable to random disturbances that can propagate to neighboring patches, forming gaps in mussel cover. The probabilities of disturbance and propagation increase as functions of mussel biomass. Using this model, we report preliminary results on how the frequencies of disturbance and the size distribution of gap sizes vary with tidal height, wave exposure, and intensity of predation. We also show how healing gaps from previous disturbances influence the dynamics of gap formation.

40. THE EFFECTS OF DIETHYLSTILBESTROL ON THYMOCYTE DEVELOPMENT OF EMBRYONIC C57BL/6 MICE

P. Escalante and Dr. Christine Broussard. University of La Verne, Department of Biology, La Verne, CA.

Diethylstilbestrol, a synthetic estrogen, poses an enormous risk to human health, especially for newly developing embryos. Between the 1930s and 1970s, Diethylstilbestrol (DES) was prescribed as a preventative of miscarriage and pre-term births to nearly 10 million pregnant women. DES is known to affect the immune system by interfering with thymocyte maturation and differentiation. We sought to determine at what doses DES can have a detrimental effect on thymocyte development. To examine T cell development under the influence of DES, we utilized an in vitro assay exposing thymocytes of C57BL/6 mouse embryos between 16 to 18 days of gestation to tenfold titrations of DES starting from 50μM all the way down to 0.005μM. We have observed a large decrease in cell viability and alterations of positive T cell selection, including TCR and CD5 signaling, in the highest 50μM concentration, however, statistically no other concentration showed significance. Current studies are investigating whether low doses of DES alter viability and population distribution in the absence of phenol red, a common pH indicator used in tissue culture.

41. FREE RADICAL POLYMERIZATION OF SUNFLOWER SEED OIL BIODIESEL (SFSO BD)

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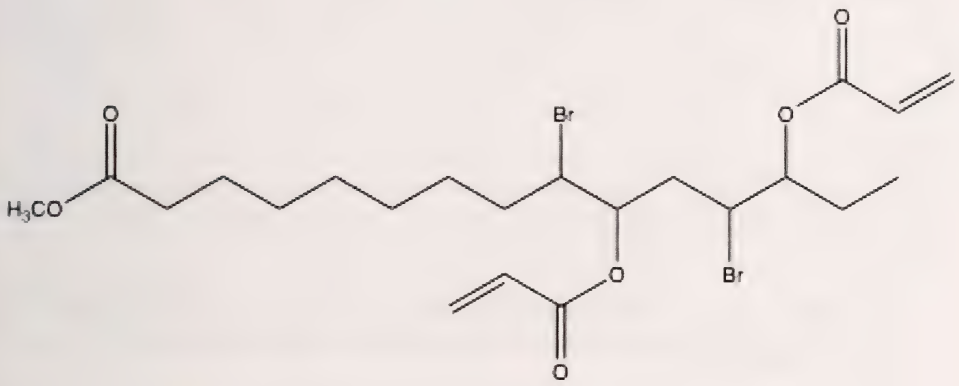
Synthesis of biodiesel via the transesterfication of seed oils and algae has been known for over a century. The Page Group has successfully converted various seed oils into Fatty Acid Methyl Esters (FAMEs).The FAME of linoleic acid has two inactive cis double bonds toward olefin polymerization. This synthetic project focuses on the activation of the alkene system with a bromo-acrylate moiety that is primed for polymerization via a free radical initiator.

The bromo-acrylation of the double bonds is completed in a one-pot transformation. Infrared spectroscopy (IR) spectrum indicates a new ester carbonyl stretching band (−OC(=O)CH=CH2) at 1729 cm^{-1}, and acrylate resonance bands were observed at 808, 1404, and 1636 cm^{-1}. Compound **1** was polymerized at 80° C using AIBN (1.5% w/w) and was confirmed by the absence of the acrylate olefin resonances in the corresponding IR.



1

The final polymerized product could be potentially incorporated into the synthesis of many common petroleum based products that are in use today.

42. QUANTIFYING TROPHIC SUPPORT FOR CALIFORNIA HALIBUT IN A RESTORED COASTAL WETLAND AS A METRIC FOR RESTORATION SUCCESS

E.J. Fox, C.L. Espasandin, C.R. Whitcraft, C.G. Lowe, and B.J. Allen. California State University, Long Beach, Department of Biological Sciences, Long Beach, CA, 90840.

Post-restoration monitoring and assessments typically focus on structural attributes of the restored habitats, but recent research has emphasized the importance of evaluations that also include ecosystem function. In this study, the recovery trajectory of a recently restored salt marsh in Southern California was assessed with respect to a reference marsh in the same wetland system that was restored 20 years ago. We used stable isotope and gut content analyses of juvenile California halibut (*Paralichthys californicus*) to quantify the development of trophic support for this key focal species. Initial results show that halibut collected within the wetland system are using food sources found within the system, with no significant differences between the two marshes. In order to calibrate a caging study that will be conducted to measure growth and isotopic signatures of halibut in specific habitats, we used a lab study to determine the minimum time needed for tissue turnover in juveniles. Halibut were fed three isotopically distinct diets, and within two months each group had isotopic signatures that were well separated from the control group and each other. Protected embayments along the California coast are believed to function as critical nursery habitats that promote increased survival and growth of juvenile halibut. Developing effective tools for assessing restoration performance in coastal wetland habitats will be instrumental in ensuring the

sustainability of this commercially and recreationally exploited species. The generality of our methods suggests that they may be applicable in a variety of restored systems and habitat types, thus providing valuable information about restoration success to land managers and ecologists.

43. EXAMINING DIVERSITY IN WESTERN *MIMULUS* (PHRYMACEAE): EVIDENCE FROM MORPHOLOGICAL AND MOLECULAR DATA REVEALS HIDDEN SPECIES

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At least 66 species of *Mimulus* are currently listed by U.S. government agencies and native plant societies as sensitive, rare, or endangered, making *Mimulus* a group of conservation concern. However, species delimitation and taxonomic relationships in *Mimulus* remain unclear, with 90 to 150 species recognized. In many recent regional treatments of the group, some previously recognized rare species with limited distributions have been lumped with more common species. Taxonomic confusion in *Mimulus* persists in part because diagnostic floral characters are often obscured when plants are pressed and dried. These easily obscured characters are informative in understanding species diversity and delimiting species boundaries within the genus. A primary objective of this study is to resolve taxonomic issues and identify taxa that are in need of conservation. Because previous taxonomic treatments in *Mimulus* have been based primarily on study of herbarium specimens, more field studies are needed. Over the course of my work I have conducted extensive field research, photographing and collecting data and plant material from more than 60 populations. As a result I have identified five undescribed species of *Mimulus*. In this study I expand previous sampling, and utilize sequences from three non-coding regions from the chloroplast genome (*petA-psbJ*, *psbD-trnT, rpl32-trnL*) to examine species limits and monophyly. Preliminary results and taxonomic implications of these data will be discussed.

44. SCRUBBING THE AIR: REDUCING CARBON DIOXIDE LEVELS WITH *FRAGARIA CALIFORNICA, GALVEZIA SPECIOSA, HETEROMELES ARGUTIFOLIA,* AND *SALVIA CLEVELANDII*

C.A. Frost. Drennan Biology Lab, Loyola Marymount University, Department of Biology, Los Angeles, CA.

This study evaluates the photosynthetic response of four plant species indigenous to Southern California, to increases in atmospheric concentrations of CO_2. The purpose is to explore the plant's photosynthetic rate and water efficiency change as atmospheric CO_2 concentrations are increased. The following four native Southern Californian plants are the subject of this study: *fragaria californica, galvezia speciosa, heteromeles argutifolia,* and *salvia clevelandii*. The photosynthetic rate as well as the rate of transpiration and other statistics was measured by a LI-COR 6400XT Portable Photosynthesis System, in the lab of Dr. Phillipa Drennan at Loyola-Marymount University. The LI-COR machine uses gas exchange principals in a sealed leaf chamber to determine the amount of CO_2 consumed in the photosynthetic process. Different plants per each species were tested and the results averaged to limit the influence of experimental error. Independent variables such as atmospheric pressure, illumination level and lab air temperature were limited by calibrating the LI-COR machine before each test. In addition, for each concentration level of CO_2, the leaf chamber was allowed to reach a steady state before measurements were taken. The study analyzed the photosynthetic rate and other statistics for 150 ppm, 300 ppm and 450 ppm increases in CO_2 atmospheric concentration. The result of the study showed only *fragaria californica*, the wild strawberry, and *salvia clevelandii*, the sage, showed increases in photosynthetic rate in response to a 150 ppm increase in CO_2 concentration. (5.4% and 17.6% respectively). All other species showed decreases in photosynthetic rate at this concentration level, with *heteromeles argutifolia* decreasing the most with a 77% decrease. At the 300 and 450 ppm increase in concentration levels, all species showed declines in photosynthetic rate. Over the 450 ppm increase only *salvia clevelandii* showed an average increase in photosynthetic rate (10.7%). All other species showed average decreases in photosynthetic rate with *heteromeles argutifolia* decreasing the most. Only the *salvia clevelandii* increased in average water use efficiency during the 450 ppm increase in CO_2 concentration. (21.7%). All of the other species showed decreases in water efficiency with *heteromeles argutifolia* showing the largest decrease.

45. A PHOTOMETRIC TOOL FOR THE CHARACTERIZATION OF ANTHOCYANIN PIGMENTS IN SYCAMORE (*PLATANUS RACEMOSA* NUTT.) LEAVES

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Anthocyanins are water-soluble flavonid pigments. Using digital image analysis, we have observed that Sycamore (*Platanus ramosa*) leaves had higher red pixel intensities at Temescal Canyon than on the Loyola Marymount campus. Our project aims to correlate digital image pixel intensities (blue, green, and red) with anthocyanin absorbance in Sycamore leaves. We found that Sycamore leaves have a pH of 4.15 and action spectra reveal that leaf anthocyanins have a max absorption at 529nm. This photometric technique provides a non destructive means to study plant defense mechanisms as well as the ability to study the ecological consequences of the principle of allocation and variability in other life functions such as growth and reproduction.

46. A TEMPORAL COMPARISON OF CYMOTHOID ISOPOD PARASITISM OF FISHES IN CAMPBELL COVE, BODEGA BAY, CALIFORNIA, U.S.A.

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Fishes were collected from Campbell Cove of Bodega Bay, Sonoma County, California, U.S.A. and examined for the presence of parasitic isopods to monitor changes since the 1986 survey by Waugh et al. (1989). The isopod *Elthusa californica* was found to parasitize *Cymatogaster aggregata* and *Atherinops affinis* with slightly less prevalence than observed by Waugh et al. (1989), but these differences were not statistically significant. Four additional host species for this isopod were also recorded. A second species of parasitic isopod previously unrecorded in Campbell Cove, *Elthusa vulgaris*, was also found on 4 host species. The presence of a second species of parasitic isopod along with the new host/parasite interaction suggests a shift in the community dynamics that should continue to be monitored.

47. COMMON GARDEN STUDY COMPARING TWO SUBSPECIES OF *TRICHOSTEMA* (LAMIACEAE) IN SOUTHNERN CALIFORNIA

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Trichostema austromontanum subsp. compactum is a narrow endemic that is listed as Threatened by the U.S Fish and Wildlife Service. A comparative study was initiated to investigate morphological differences between *T. a.* subsp. *compactum* and *T.a.* subsp. *austromontanum*. The genus *Trichostema* was revised by Harlan Lewis in 1945, in which he described the two subspecies based on several morphological characters. In his revision he stated that these subspecies maintained their morphological differences when grown together in a common garden, however no data was published to support this claim. Morphometric measurements were recorded from one population of each subspecies *in-situ* and in a common garden at Rancho Santa Ana Botanic Garden. Results from this experiment and their taxonomic implications will be discussed.

48. TEMPORAL AND SPATIAL PATTERNS IN DEMERSAL FISH COMMUNITIES ON THE CONTINENTAL SHELF OFF SAN DIEGO BETWEEN 1991 AND 2009

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Demersal fishes are important members of continental shelf ecosystems whose species are often characterized by inherently variable populations subject to both natural and anthropogenic influences. Thus, assessing change in these communities over space and time has become an important part of ocean monitoring programs throughout the world. For example, the City of San Diego has conducted trawl

surveys surrounding the present discharge site for the Point Loma Ocean Outfall (PLOO) since 1991, while similar surveys surrounding the South Bay Ocean Outfall (SBOO) have been conducted since 1995. These surveys are generally designed to monitor the structure and stability of trawl-caught fish communities to assess possible effects of wastewater discharge or other influences. While results for the PLOO and SBOO surveys have been analyzed previously as part of regular reporting requirements, the data have never been evaluated together. Therefore, the goal of this project was to combine data from both programs to attain a broader synoptic understanding for the entire region. To accomplish this we analyzed trawl data collected over 19 years (1991–2009) using PRIMER software to examine patterns in the overall similarity of fish assemblages. Specific analyses included cluster analysis (hierarchical agglomerative clustering with group-average linking), non-metric multidimensional scaling (MDS) ordination, similarity profile analysis (SIMPROF) to confirm non-random structure of the dendrogram, and SIMPER analysis to identify individual species that distinguish cluster groups. Prior to analysis, data were screened following protocols established for the Bight'03 regional monitoring program to reduce the confounding effect of rare species. Cluster results were further explored by summarizing various parameters (e.g., species richness, abundance, average abundance per species, etc.) by cluster group, as well as plots of common species over time. Preliminary results demonstrate that the two regions are distinct in terms of the most abundant and frequently occurring (i.e., common) fishes, which primarily reflect habitat differences. For example, Pacific sanddabs dominated deeper (~100 m) water habitats off Point Loma with sediments composed predominantly of coarse silt and very fine sands. In contrast, speckled sanddabs dominated shallower (~30 m), nearshore habitats located off Imperial Beach typically characterized by coarser, sandy sediments that often also contain high levels of shell-hash.

49. THE EFFECTS OF HABITAT STRUCTURE ON WESTERN GRAY SQUIRRELS AND INVASIVE EASTERN FOX SQUIRREL

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The invasive eastern fox squirrel (*Sciurus niger*) replaces the native western gray squirrel (*Sciurus griseus*) in certain habitats in Southern California, while both species coexist in other habitats. A third habitat type supports only *S. griseus*. Therefore, study habitats can be divided into three types: (1) habitats which support *S. griseus* while excluding *S. niger*; (2) habitats which support both species and (3) habitats in which *S. griseus* was completely replaced by *S. niger*. My objective was to construct a Habitat Suitability Model to determine which habitat variables best predict each habitat type. Nine habitat variables were measured for each study site of the three habitat types. Discriminant analysis determined which measure(s) give the greatest separation among habitat types by using habitat characteristics which account for the largest amount of variation between habitat types. A test of overall significance was significant ($p<0.01$), indicating it is possible to discriminate between the habitat types. Forward stepwise regression analysis identified three variables that can be used to distinguish between the habitat types: 1) percent tree canopy cover; 2) percent of total trees that are deciduous; and 3) average height of ground cover. A concurrent study at Rancho Santa Ana Botanic Garden in Claremont, California is the first field test of the model which will evaluate its predictive value. The results of this study can be utilized by conservation managers to increase survivorship of *S. griseus* and hinder expansion of *S. niger*.

50. METHOD DEVELOPMENT OF HIGH PERFORMANCE LIQUID CHROMATOGRAPHY TECHNIQUES IN THE CHARACTERIZATION OF EXTRAFLORAL NECTAR SUGARS

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Extrafloral nectar glands (EFN) are specialized structures found on the leaf petioles, mid-rib or leaf margins of a plant that have evolved over time as a defense mechanism for plants. EFN glands secrete a complex mixture of sugars, amino acids, lipids, and other organic compounds such as alkaloids and phenolics. The objective of our study employs high-pressure liquid chromatography (HPLC), a technique used to separate the complex mixtures of aqueous compounds in order to characterize sugars secreted by EFN glands. The HPLC was outfitted with a refractive index detector, and samples were run through a C-

18 Carbohydrate reverse phase column. The results of our method development indicated that glucose, sucrose, and fructose dissolved in milliQ water at a flow rate of 2–3 ml/min with a column temperature of 40°C with 80–85% Acetonitrile mobile phase produced the best peak resolution. The EFN sugar secretion may be a form plant defense that has been greatly underestimated in the field of Ecology, whereby the degree of specialized interaction between plants and ants may be determined by the types of sugar found in the EFN. The methods developed in this project will aid in understanding plant defense and the evolution of ant-plant mutualisms.

51. LIFE CYCLE AND DEVELOPMENT OF *HAMINOEA VESICULA* IN SOUTHERN CALIFORNIA

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A species of opisthobranch from Japan, *Haminoea japonica,* has invaded a small number of bays and estuaries in and north of San Francisco Bay. In many, it has displaced the native species, *Haminoea vesicula*. So far, it is unknown exactly why *H. japonica* has not traveled farther south, but one hypothesis is because *H. vesicula* is a better competitor in the warmer waters south of San Francisco Bay, decreasing the invasiveness of these regions for *H. japonica*. To determine whether this is the case, we have been sampling a population of *H. vesicula* at Colorado Lagoon in Long Beach and collecting data on the size of the individuals sampled. So far, the data we have collected indicates that this species has either a bi-annual life cycle or a yearlong reproductive period. In addition, the veliger larvae of *H. vesicula* appear to be planktotrophic and the southern population has been found to have a quicker development period than northern populations of this species. One possible scenario based on the data obtained is that *H. vesicula* was originally a southern species that expanded its range north because of a lack of competition, but when *H. japonica* arrived, *H. vesicula* was unable to successfully out-compete the invading populations in the north.

52. THE PALEOENVIRONMENT OF PLUVIAL LAKE MOJAVE IN THE MOJAVE DESERT OF SOUTHERN CALIFORNIA

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The environment of pluvial Lake Mojave at the end of the Pleistocene and the beginning of the Holocene is based on reconstructions derived from paleoenvironmental data, which includes lake sediment cores taken from Soda Lake Playa in the Mojave Desert of Southern California and *Neotoma* middens collected from the central region of the Mojave Desert. In addition to the cores and middens, proxy data are derived by looking at global, continental, and regional climate data and forcing mechanisms developed through the applications of climate models. The results of the combination of these methods and models describe an environment with major climatic and biotic differences from what we witness today. Over the 6,000 years between 13,000 and 7000 B.P., the climate of pluvial Lake Mojave was cooler than today, with increased precipitation and cloud cover, higher humidity, and a corresponding decrease in the evapotranspiration rate. This climate provided for a floral biome that included piñon pine, juniper, and Joshua trees to exist at elevations much lower than at the present, and provided a diverse ecosystem that was able to support populations of early humans in the region.

53. PHYSIOLOGICAL CONSEQUENCES OF THERMAL STRESS ON GROWTH AND SURVIVAL OF THE MARINE SNAIL, *LOTTIA GIGANTEA*

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Marine intertidal invertebrates are likely to be especially vulnerable to global warming as their physiology, behavior, and demography are all critically influenced by local environmental temperatures. Nevertheless, the mechanistic links between abiotic conditions and individual performance are not yet

well understood. We are using the owl limpet, *Lottia gigantea*, as a model organism to identify the physiological consequences of thermal stress on key demographic parameters. Abundances of *L. gigantea* in the mid-intertidal zone are negatively related to maximum temperature, suggesting that this species may already be living near its upper thermal tolerance limits. We transplanted marked limpets into intertidal plots across a wave exposure gradient on a rocky headland in Rancho Palos Verdes, CA, and are tracking limpet growth and survival monthly as a function of local temperatures. We also exposed limpets to one of five body temperatures (18°C, 24°C, 28°C, 32°C and 36°C) for several hours during a simulated low tide under controlled conditions in the laboratory before extracting and analyzing proteins from gill tissues. Environmental proteomics is a biotechnological approach that allows one to analyze simultaneously the expression levels of many proteins in response to different environmental conditions. Protein expression profiles varied characteristically among treatment groups; we are currently working to identify with mass spectrometry the proteins most responsible for those differences. The ability to link effects of abiotic stress on individual growth and survival to protein-based bioindicators will provide insight into the potential responses of individuals and populations to future environmental conditions.

54. GROWTH INHIBITION OF *MYCOBACTERIUM TUBERCULOSIS* USING NATURAL KILLER CELLS ISOLATED FROM HEALTHY AND HIV INFECTED SUBJECTS

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Glutathione (GSH), an anti-oxidizing agent plays a vital role in facilitating *Mycobacterium tuberculosis (M. tb)* growth inhibition within cell types. HIV infected individuals have below normal GSH levels and are susceptible to *M. tb* infections due to immunodeficiencies. Studies using isolated natural Killer (NK) cells from healthy and HIV infected individuals have shown inhibitory growth effects of *M. tb* within infected human monocytes when adequate levels of GSH are present within NK cells. Addition of N-acetyl cysteine (NAC), a precursor to GSH in combination with IL-2+IL-12 to NK cells derived from both healthy individuals and individuals with HIV infection resulted in control of *M. tb* infection and the growth inhibitory effects correlated with increased expression of FasL and CD40L on cell surface of NK cells. Our results indicate a novel pathway by which NK cells control the growth of *M. tb* inside human monocytes and this protective innate defense mechanism is somewhat compromised in individuals with HIV infection leading to enhanced susceptibility to *M .tb* infection.

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55. THE INTERACTION OF LIGHT AND DEHYDRATION ON LEAF HYDRAULIC CONDUCTANCE

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The leaf hydraulic conductance (K_{leaf}) is a variable that describes the capacity for water movement through the whole-leaf system, and can determine the ability to open stomata for photosynthetic assimilation. Previous work has shown a strong light enhancement of the leaf hydraulic conductance for well hydrated leaves of many species from darkness to high irradiance. Numerous recent studies have also shown that K_{leaf} declines in dehydrating leaves, due at least in part to cavitation in the leaf vein xylem. We aimed to determine the impact of light on the K_{leaf} response to dehydration, comparing leaves illuminated with >1000 μmol photons $.m^{-2}.s^{-1}$ photosynthetically active radiation with leaves under ambient lab light (< 20 μmol photons $\cdot$ m^{-2} $\cdot$ s^{-1}), using the evaporative flux method. We also determined the impact of light on the response of stomatal conductance (g_s) to

dehydration. For the three species tested (*Alberta magna, Hedera canariensis, Raphiolepis indica*), under high irradiance K_{leaf} was greater for hydrated leaves, and decreased more strongly with declining leaf water potential (ψ_{leaf}), such that K_{leaf} became negligible at approximately the same ψ_{leaf} under both irradiances. For all species g_s was higher for light acclimated leaves than shade acclimated leaves, and declined similarly with ψ_{leaf}. This study provides new evidence for a light effect that interacts with the impact of dehydration on the hydraulic and stomatal conductances. We explore possible mechanisms for these effects.

56. ANTIFUNGAL ACTIVITY OF AMBISOME® AND CANCIDAS® COMBINATION THERAPY IN THE TREATMENT OF SYSTEMIC CANDIDIASIS CAUSED BY *CANDIDA TROPICALIS*

D. Hahka*, J. Olson, and J. Adler-Moore. Biological Sciences Department, Cal Poly Pomona.

Introduction: Candida species are the fourth most common cause of hospital-acquired blood infections, with immunosuppressed individuals at highest risk. The focus of the present investigation was to identify better treatments for non-*albicans* candidiasis since the mortality rate of current treatments ranges from 10% to 40%.

Materials and Methods: Mice were immunosuppressed with cyclophosphamide (200mg/kg d-2, 150mg/kg days 0, 2, 4) and challenged iv d0 with *C. tropicalis* at 5x10ex4 cells/mouse; 24h later, iv treatment (tx) was given d1-6 (2.5 or 10mg/kg AB, 7.5mg/kg Cs, 2.5mg/kg AB + 7.5mg/kg Cs, 10mg/kg AB + 7.5mg/kg Cs or 5% dextrose, D5W). Day 7, tissues were collected (spleen, kidney, liver, heart, lung, brain) to determine $\log_{10}$ colony forming unit (cfu) and cytokines; morbidity was followed to d21.

Results: All drug treatments significantly reduced Log_{10} CFU/g in all collected oragns compared to D5W. Increased survival compared to D5W (0%) was only observed with 10AB (71%) or 10AB + 7.5Cs (57%). The 2.5AB tx had the highest proinflammatory tissue cytokine levels which may have contributed to its poor survival rate (0%).

Conclusions: The data suggests that the drugs used together are not antagonistic and there may be some benefit in the reduction of tissue fungal burden when AB and Cs are used together.

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57. THE EFFECT OF GATORADE PRIME 01 ON STUDENT ATHLETES' ENDURANCE

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Millions of dollars are spent every year on pre-exercise sports drinks in hopes of improving an athlete's performance. Gatorade claims that its Gatorade Prime 01 will increase an athlete's endurance, but does not provide clear evidence of its benefits to the everyday consumer. The purpose of this study is to determine if drinking the new Gatorade Prime 01 sports drink 15 minutes prior to exercise will improve male athletes' endurance. Five male adolescent basketball players participated in a random, double blind test consuming one ounce per 25 pounds of body weight of either Gatorade Prime 01 or flavor-enhanced water in two training sessions. The Akstrand Treadmill test was administered and participants ran at 5 mph starting at a 2.5% grade incline. The incline increased at 2.5% grade increments at 3 minutes, 5 minutes, and 7 minutes reaching a maximum 10% grade incline. Timed measurements were recorded for the duration of the athlete's activity until exhaustion. VO2 max, the volume of oxygen consumed, was calculated to determine the athlete's general endurance. The results showed that four of the five athletes' VO2 max improved after consumption of Gatorade Prime 01 compared to consumption of flavor-enhanced water. After consuming Gatorade Prime 01, athlete 1, 2, 3, and 5 had a VO2 max of 33.74, 31.05, 38.21, and 34.83 ml/kg/min, respectively. After consuming the flavor-enhanced water, athlete 1, 2, 3, and 5 had a VO2 max of 32.37, 28.67, 34.62, and 30.05 ml/kg/min, respectively. After consuming Gatorade Prime 01, athlete 4 had a calculated VO2 max of 27.47 ml/kg/min, which was slightly decreased, compared to consuming the flavor-enhanced water with measured VO2 max of 27.49 ml/kg/min. This exhibits an overall mean average increase of 7.81% with a standard deviation of 5.42. Preliminary results from this study indicated that consumption of Gatorade Prime 01 prior to an athletic task may improve an athlete's endurance. However, more testing is needed to support fully the company's claim.

58. CLAST ANALYSIS OF QUATERNARY GRAVELS ALONG THE EAST-CENTRAL SAN GABRIEL MOUNTAIN FRONT: IMPLICATIONS FOR EVOLUTION OF THE SIERRA MADRE-EVEY CANYON THRUST SYSTEM

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The Sierra Madre-Evey Canyon thrusts are part of an active fault system that transects the east-central San Gabriel Mountains. These fault segments, situated adjacent to densely populated communities, are poorly understood. Our efforts focused on southward extending gravels associated with the uplift and erosion of the hanging walls of the thrusts to understand the regional geologic setting. We mapped and sampled portions of two uplifted basement blocks and collected pebble samples of related gravels for clast analysis. The Sunset Ridge Block (SRB) forms the hanging wall of the north-dipping Evey thrust. This block is composed of a layered sequence of distinctive plutonic and metamorphic rocks. The Potato Mountain Block (PMB) is located farther south in the footwall of the Evey fault and the hanging wall of the active Sierra Madre thrust. Stratigraphic relationships indicate two generations of gravel deposits. Clast analyses of eight gravel samples and field observation of boulders from two sites yielded systematic provenance ties to the two basement blocks and a consistent time progression: older gravels were derived from the SRB while younger gravels shed from PMB bedrock sources. These data indicate the two fault blocks were uplifted sequentially such that early displacement on the Evey thrust (coincident with uplift of SRB) was succeeded by activation of the Sierra Madre thrust (and uplift of PMB). Thus the two gravel units denote southward transfer of slip from Evey Canyon to the present-day mountain front. Pending cosmogenic dating results will help identify the uplift rate of the Quaternary gravels.

59. THE INVASION PATHWAY OF THE JAPANESE BUBBLE SNAIL *HAMINOEA JAPONICA*

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The invasive cephalaspidean *Haminoea japonica* has been hypothesized to disperse in association with oyster and clam spat introduced for aquaculture purposes. *H. japonica* is a carrier of cercarial dermatitis (swimmer's itch) and is an aggressive competitor to native species. Analysis of the CO1 gene from North American, European, and Japanese specimens has revealed two very distinct Japanese haplotypes and three haplotypes shared between North America and Europe but not found in Japan. However, the H3 gene has shown no difference between any populations. Scanning electron microscopy of radulae and gizzard plates shows little morphological difference between populations. These phylogenies suggest that there may be a high degree of population structure in Japan, possibly correlated with temperature. The Japanese specimens were collected in Kurihama Bay, near Tokyo, where ocean temperatures are much warmer than off the coast of North America or Europe. If a cold-water Japanese haplotype invaded either of these locations, it may be unable to effectively disperse to warmer environments. This has important implications in controlling the spread of the non-native populations. The similarity between European and American populations in the CO1 gene compared to the Japanese populations further suggests that the European population may have been introduced from North America, rather than Japan.

60. DBF4 PROTEIN EXPRESSION LEVELS THROUGHOUT THE CELL CYCLE

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Dbf4, dumbbell former protein is essential in the initiation of DNA replication in *Saccharomyces cerevisiae*. Dbf4 is expressed in the cell cycle continually from S phase to M phase. During late G1 many proteins assemble onto the origin recognition complex (ORC), these proteins include Cdc6, Mcm 2–7, and Cdc45. Once proteins assemble onto chromatin the origin is licensed for DNA replication. Dbf4 binds to chromatin and recruits Cdc7 which then forms a kinase complex. This kinase complex triggers initiation of replication origins after the assembly of pre-replicative complexes. Once Cdc7/Dbf4 binds to chromatin it participates in a phosphorylation step, phosphorylating Mcm proteins, and alleviating the inhibitory

activity of Mcm4. Mcm proteins (2–7) are 6 related polypeptides that recruit proteins to the pre-RC complex. Once Cdc7/Dbf4 phosphorylates Mcm, Mcm dissociates from chromatin leading to the start of DNA replication. The phosphorylation of MCM by the Cdc7/Dbf4 kinase complex is very important, if this step doesn't occur DNA replication won't occur causing the cells to arrest in late G1, early S phase. Previously, in the laboratory the Dbf4 protein was tagged with a red fluorescent protein (RFP) in order to see the Dbf4 protein in the yeast cell. Because the proteins dissociate from chromatin and the origin of replication complex (ORC) after the initiation of DNA replication, we wondered if Dbf4 remains bound to the chromatin, in the nucleus or migrates out to the cytoplasm. Therefore, I have begun to examine the subcellular location of RFP-Dbf4 during different phases of the cell cycle in yeast by fluorescence microscopy.

61. SEED PRODUCTION AND PATTERNS OF SEED DISPERSAL IN DESERT HOLLY, *ATRIPLEX HYMENELYTRA*

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Studies of the population dynamics of desert holly (*Atriplex hymenelytra:* Chenopodiaceae) have been ongoing at sites within the Mojave National Preserve since 1991. Over this 20 year period, the abundance of mature plants have slowly declined as mortality has steadily outpaced episodic recruitment events. This study focuses on two factors that may contribute to recovery of this dioecious species: seed production and the dispersal of seeds to sites conducive to their germination and subsequent growth as seedlings. Bracts (fruits), each enclosing a single seed, were collected from the same set of females (n=10) in each of three years (2008, 2009, and 2010). Among-year comparisons in the number of bracts produced will provide a measure of inter-annual variation in seed production by individual females. As bracts are shed from isolated females (n=10) beginning in late April 2011, bracts will be trapped, as well as marked, as a means of measuring the effects of wind direction and speed, slope aspect, and the presence of structural elements (living and dead plants) on seed dispersal patterns and capacity (maximum dispersal distance). By examining the most basic of factors that can affect the supply of new recruits to this population, at least one side of the equation that can tip the balance between population growth and decline can be better understood.

62. RIGHTS-BASED MANAGEMENT FOR TUNA STOCKS — THE SOLUTION TO OVERCAPACITY?

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Most tuna stocks are fully exploited, some overexploited, and all facing growing fishing pressure from excessive fishing capacity, that is, the existence and use of more fishing capacity than needed to harvest the available catch. Excess fishing capacity leads to overfishing and threatens sustainability of the tuna resources. Current management regimes such as the use of quotas or time-area closures have not solved the capacity problem. Only by extending and strengthening the rights to access the fishery and harvest tunas to the individual fisherman can the problems of overfishing, overcapacity, damage to the ecosystem, and low economic benefits be effectively addressed. The use of "rights-based management" (RBM) schemes allows participants to rationalize their capital investments, and equally important, provide more secure harvesting rights that strengthens their interest in the conservation of the stocks by removing the incentive to race to catch fish. Various types of RBM schemes are discussed.

63. SURVEY OF SOFT BOTTOM BENTHIC COMMUNITIES NEAR POTENTIAL RENEWABLE ENERGY SITES OFFSHORE THE PACIFIC NORTHWEST

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The wave and wind climates along the west coast of North America represent one of the best prospects for the development of offshore renewable energy, yet initial assessments of the potential ecological effects have only just begun. This is the first year of a four year study to research the regional distribution of benthic invertebrate communities and habitats of the Outer Continental Shelf off of Washington, Oregon, and northern California. The objective of this study is to determine species-habitat relationships and develop predictive capabilities as to where benthic invertebrate species of interest may occur. Surveys and sample collections have begun in six areas that have the potential to be developed for renewable energy on the Pacific Outer Continental Shelf. In 2010, 118 box core samples were collected in depths ranging from 40 to 130 meters. This sampling will be analyzed with existing physical and biological datasets to determine the distribution of species-habitat associations more broadly throughout the region and, potentially, how they vary over time. Understanding species-habitat associations throughout the region will be a powerful tool to plan lease sales for renewable energy for the Pacific Northwest and for determining the nature and extent of further seafloor explorations.

64. FEEDING MEETS REPRODUCTION: JAW MECHANICS AND DIETARY BREADTH IN THE BEACH-SPAWNING GRUNION SISTERS (*LEURESTHES*) COMPARED TO THEIR RELATIVES (TELEOSTEI: ATHERINOPSIDAE)

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We compared jaw mechanics and dietary breadth in the sister atherinopsids *Leuresthes tenuis* (California grunion) and *L. sardina* (Gulf grunion) along with three other members of the Atherinopsini to test whether the two grunion species have evolved a novel jaw protrusion that might be associated with feeding narrowly on abundant prey near the spawning beaches. Quantitative comparison of cleared-and-stained specimens of five members of the atherinopsine clade showed that, compared to false grunion (*Colpichthys regis*), topsmelt (*Atherinops affinis*), and jacksmelt (*Atherinopsis californiensis*), *L. tenuis* and *L. sardina* have longer (5.1% vs 0.9%), more downwardly directed (−37° vs. +0.1°) premaxillary protrusion, an expanded dentary bone (61° vs 37°), greater lower jaw rotation (65.3° vs 13.8°), and greater premaxillary-vomer spacing (36.6% vs 20.9%). California grunion showed the most divergence in these features. For dietary analysis, adult *L. tenuis* and *A. affinis* were collected offshore, simultaneously with zooplankton samples to represent prey availability. *L. tenuis* fed heavily on mysid crustaceans, and, as predicted, had a narrower diet than *A. affinis* in the same habitat, as shown by higher L selectivity (0.5 vs 0.1) and lower H′ diversity (0.8 vs 1.6), and J evenness (0.5 vs 0.8) values. Information available on *As. californiensis* and *C. regis* indicate that these species have broad diets associated with benthic feeding. Limited data on *L. sardina* indicates a crustacean diet. *L. tenuis*, especially, appears to have evolved a unique jaw mechanism that may allow efficient feeding on common, evasive prey near spawning sites.

65. EXAMINATION OF PHYSIOLOGICAL AND BEHAVIORAL EFFECTS ON WHITE SEABASS *ATRACTOSCION NOBILIS* IN A CLOSED RECIRCULATING SYSTEM

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Over the past 25 years the white seabass, *Atractoscion nobilis,* has been propagated in open seawater systems as a means to sustain population of the commercially important fish. This study examines the feasibility of, and baseline parameters necessary for, growing white seabass in a closed recirculating system. Juvenile white seabass were obtained from Hubbs-Seaworld Research Institute and held for 90 days in aquaria containing artificially mixed saltwater. Water flow, water chemistry system design, light conditions, seawater composition, behavior, feeding rate, growth rate, stocking density, and animal stresses were documented. The fish were held at an average temperature of 19.0 Â°C. Other than water chemistry and lighting, the conditions and behaviors for the fish were very similar to that of the open water systems. Throughout the study, the main discrepancies occurring in an artificial environment rather than in a natural one were periods of high nitrate and nitrite levels, fish eating behavior, and color changes in the fish based on lighting At the end of the 90 day trial period, 91% of 22 fish survived.Â Loss of only 9% of the animals is well within the acceptable losses that occur in white seabass cultured in open water

systems. While this study documents the feasibility and baseline parameters necessary for the propagation of white seabass, additional experimentation is need to optimize fish growth.

66. STRUCTURE CHARACTERIZATION OF A SERINE PROTEASE AUTOTRANSPORTER OF *ENTEROBACTERIACEAE*

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Serine protease autotransporters of the *Enterobacteriaceae* (SPATEs) are proteins secreted by gram negative bacteria which assist in bacterial pathogenicity. Several conserved residues in the SPATE proteins were suggested to participate in maintaining stable intramolecular interactions among different domains of the protein. The SPATE protein temperature sensitive hemagglutinin (Tsh) of avian pathogenic *E.coli* was used to characterize the importance of this intramolecular interactions, and the consequences of interruptions to this interactions. Interaction between catalytic globular domain and helical stalk domain involving residues L441, L450, and T164 were characterized by intrinsic fluorescence of tryptophan residues in Tsh, which indicated the folding state of the protein. Pure Tsh was obtained from Superdex 200 prep grade column, eluted with 20 mM Tris-HCl, pH7.4 buffer containing 0.05M NaCl. Pure Tsh was collected and visualized with Western blot, along with silver stained SDS-PAGE. A Colorimetric (Oligopeptide) assay was conducted to analyze the proteolytic activity of pure wild type and mutant Tsh. Fluorescence intensities were measured with excitation at 280 nm, emission was measured ranged from 290 nm to 450 nm. Fluorescent intensities were collected between 27°C to 80°C. All pure mutants Tsh demonstrated increased in fluorescence intensity when compared to that of the wild type. Disruptions of intramolecular interaction between different domains of Tsh were shown to cause structure conformational and proteolytic activity changes. Further detail structural characterization will be resolved with circular dichroism spectroscopy.

67. SYNTHESIS OF DISCOTIC LIQUID CRYSTAL DIMERS FOR PHOTOVOLTAICS

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Discotic liquid crystals are organic materials that have the film-forming properties of a liquid and the long-range order associated with a crystalline solid. Columnar phases formed by discotic liquid crystals are of interest because they allow fast charge migration through self-organized polyaromatic cores and thus show potential for use in organic photovoltaics (OPVs). The hexagonal columnar phase of hexapentyloxytriphenylene (HPT) was among the first to be studied and has a charge carrier mobility (holes) of $10^{-3}cm^2/Vs$. We present our current efforts toward synthesizing triphenylene-based discotic dimers linked by a conductive bridging unit. These discotic dimers are designed to increase charge carrier mobility by providing additional migratory routes for charge carriers around film defects that serve as deep traps. They will also have broad absorption of visible light unlike HPT which absorbs only in the UV. This will allow for more efficient charge carrier generation over a broader spectrum. HPT can be synthesized from the oxidative cyclization of dipentyloxybenzene. Monohydroxypentapentyloxytriphenylene can be synthesized from HPT using B-bromocatecholborane as an ether-cleaving reagent. Nickel-catalyzed cross-coupling of thiophene Grignard reagents with tetrazoyl ethers of monohydroxypentapentyloxytriphenylene were explored as a means to connect two triphenylene cores with a conducting oligothiophene-based stannanes with aryltriflates derived from monohydroxypentapentyloxytriphenylene to achieve the same result.

68. PALEODOGS: A REVIEW OF THE EARLIEST EVIDENCE FOR DOMESTIC DOGS IN SOUTHERN CALIFORNIA AND THROUGHOUT THE AMERICAS

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Dogs were domesticated in the Old World sometime between 32,000 and 15,000 years ago and then brought from Eurasia into North America by Paleoindians between 11,000 and 14,000 years ago.

Archaeological evidence for the earliest domestic dogs in the Americas including Southern California is discussed. Skeletal pathology identified in some dogs found at Paleoindian sites suggests that they carried packs or harnesses on their backs. Ethnographic accounts indicate that dogs were used for a variety of purposes, including hauling and carrying goods, hunting and herding, as sentries and companions, as a source of food, and for their hide, fur, and bones. Paleoindians probably used dogs in the same or similar ways. Paleoindians are generally considered to be highly mobile hunters and foragers as they spread out across the Americas. Archaeological and ethnographic evidence suggests that these paleodogs may have facilitated rapid transport and enabled Paleoindians to carry more goods over longer distances and at a quicker pace than would have been possible without them.

69. TOXIN RELEASE AND AUTOLYSIN ACTIVITY IN *CLOSTRIDIUM BOTULINUM*

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Clostridium botulinum is an anaerobic bacterium which produces seven botulinum neurotoxins. Botulinum neurotoxin causes botulism, a neuroparalytic disease found in humans and animals. Previous studies have shown that the production of this toxin is temporally regulated, and that it's released as early as mid-log phase of bacterial growth. The early toxin release may be correlated with autolysins, the cell wall lysis enzymes. In this study we compare the autolysin activity in TPM and TPGY. We also want to determine if the autolysin activity is correlated with the release of the toxin. The bacteria were grown in TPM or TPGY media, and the culture supernatant samples were collected at various time points over a nine-hour period. ELISA was performed to determine the amount of toxin present in each sample. The autolysin activity was determined based on the lysis of cell walls. The release of ATP into culture supernatant samples was measured as a cellular marker for cell leakage. Cells grown in TPGY grew quicker and produced higher OD readings. However, the bacteria lysed faster in TPM and had high autolysin activity. Toxin release levels were also higher in TPM. ATP analysis confirmed high concentrations of ATP released during mid-log phase, which correlates cell lysis to the release of the toxin. Future plans include performing microarray analysis to compare gene expression profiles of the bacterium grown under different cultural conditions, and confirming whether the amount of toxin released is correlated with the activity of specific cell wall lysis enzyme(s) and/or other gene products.

70. "RESTORATION" OF SOUTHERN CALIFORNIA ESTUARIES AS OPEN SYSTEMS CONFLICTS WITH HISTORIC LANDSCAPE PROCESSES

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Approximately one billion dollars has been spent on estuary "restoration" in southern California. This appears to frequently involve type conversion. Systems that were historically isolated from the sea for part or all of the year are rendered fully open/tidal estuaries through dredging and jetty construction. To better understand California estuaries, we conducted a geomorphic assessment of formation process and developed a metric of degree of closure suitable for quantification of historic, air photos, maps and documents. Historic resources clearly indicate the seasonal or intermittent closure of systems that have been "restored" to open/tidal conditions. Furthermore this opening appears to have a suite of unintended, largely negative, consequences. These revolve around the loss of freshwater in a seasonally dry climate where flood-control structures already drain the landscape. In this context, "restoration" to open tidal conditions exacerbates negative impacts on groundwater resources, as well as on riparian and freshwater flora and fauna. This includes, bird, reptile, amphibian and fish species that are federally endangered or are species of special concern. In addition to these biological consequences, the opening of estuaries through the summer facilitates the movement of sand from the beach to the lagoon and the movement of pollutants from the lagoon to the beach. This ensures that "restorations" have high ongoing maintenance costs in terms of dredging, a significant carbon footprint and public health consequences. These negative impacts, many of them evident in "restorations" already in place, should be considered in analyses of ongoing and planned estuarine restoration in Southern California.

71. SPECIATION, CONSERVATION GENETICS, AND HYDROLOGIC CONTROL ON DISPERSAL IN THE GENETICALLY SUBDIVIDED TIDEWATER GOBIES

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The North Pacific "bay gobies" (Gobiidae: Gobionellinae) include approximately 17 eastern Pacific temperate and subtropical largely estuarine species with the greatest diversity found from California to the Gulf of California. These species tend to prefer discrete types of estuarine habitat. Federally endangered tidewater gobies, of the genus *Eucyclogobius* are exclusive to the coast of California and strongly prefer seasonally closing habitat. Reproduction is confined to the summer months, when estuaries close and freshen; consequently, oceanic larval dispersal is lacking. Tidewater gobies from Orange and San Diego Counties are deeply divergent (1 to 2 million years) in both mitochondrial and nuclear sequence and are morphologically distinct from populations to the north. This southern lineage (southern tidewater goby) is a separate species by any reasonable criterion, and it is under immediate threat of extinction as it persists in only three to five ephemeral sites. "Restoration" that permanently opens estuaries to the sea further complicates the tidewater goby recovery. Our data also indicate that rocky headlands function as impassible barriers to tidewater gobies yielding a dozen local genetically isolated units along the coast from Los Angeles to the Oregon border. These have not experienced gene flow for several millennia, resulting in the greatest local genetic subdivision of any west-coast vertebrate. Moreover, microsatellite data document hydrologic control of dispersal, where significant rainfall and resultant stream flow opens estuaries to the sea, permitting adult movement along sandy coasts in years with high precipitation and stream flow.

72. DEVELOPMENTAL CHANGES IN XYLEM VESSEL STRUCTURE IN RESPROUTING CHAPARRAL SHRUBS

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Post-fire chaparral shrub resprouts are particularly susceptible to drought and resprout mortality has been observed in some species when extreme drought occurs the year after a fire. This increased susceptibility of resprouts may be linked to shifts in xylem structure; however, little work has been done to examine how xylem vessel structure may change during this developmental transition. The purpose of the present study was to examine xylem structural changes in resprouting plants of 8 chaparral species as compared to unburned plants of the same species. Measured traits included vessel length, vessel diameter, connectivity, and pit area. All species displayed differences in vessel structure when one year old resprouting plants were compared to unburned plants. Resprouts generally had significantly shorter vessels and increased vessel diameters compared to unburned plants. Large changes in other traits, such as vessel clustering and density, were observed for some species. Vessel structure in linked to plant hydraulic function and resprouting plants may be more susceptible to drought than unburned plants because of changes in their xylem structure. Additionally, we show that many xylem vessel traits can change developmentally suggesting that many vessel traits display developmental plasticity. No single trait in informative of all developmental changes in vessel structure. Thus, we present evidence that modeled traits that incorporate multiple components of the vessel network into a single measure, such as connectivity and pit area, are most informative in prediction of plant functional shifts.

73. PALEOINDIANS IN SOUTHERN COASTAL CALIFORNIA AND BEYOND

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During the terminal Pleistocene (ca. 14,000–11,000 years B.P.), highly mobile hunters from Eurasia crossed the Bering Land Bridge that was exposed between Siberia and Alaska when world-wide sea levels dropped as much as 125 meters. The two most likely routes taken by Paleoindians as they entered North America involved either 1) following an ice-free corridor exposed between two major continental ice sheets

in the western interior of Canada that allowed access to the northern Great Plains, or 2) traveling down the Pacific coast of North America via some type of watercraft, a route that has been referred to as the "kelp highway." Archaeological remains from these two migrations appear to reflect different adaptations and may account for differences in artifact assemblages. Evidence for these two Paleoindian adaptations is discussed with regard to the earliest archaeological sites in Southern Coastal California and elsewhere in the Americas, especially in light of a recent report in *Science* by Erlandson et al. (2011) and their significant archaeological data from the northern Channel Islands.

74. BIOGEOGRAPHICAL VARIATION IN TROPHIC INTERACTIONS ON TEMPERATE REEFS OF THE SOUTHERN CALIFORNIA BIGHT

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In many aquatic systems top predators strongly influence primary production and community structure by reducing herbivore abundance. However, the trophic role of individual predator species often varies within similar habitat over geographic space. Sea urchins are the primary grazer of temperate subtidal reefs worldwide and in the absence of predators are capable of creating barrens devoid of macroalagae. Within subtidal reefs of the Southern California Bight (SCB), predators such as sunflower stars *(Pycnopodia helianthoides)*, California spiny lobster *(Panulirus interruptus)*, and the labrid fish sheephead (*Semicossyphus pulchur*) may control sea urchin populations, but studies testing for strong top-down control of urchins are lacking at broad spatial scales. We conducted surveys and tethering experiments at 19 sites spanning over 1700 km in the SCB to assess the generality, mechanisms, and strength of potential trophic cascades induced by these predators. We found a significant negative correlation between the abundance of predators and urchins across all study sites. However, this relationship appears to be site specific, with many sites harboring high densities both of predators and urchins. Tethering experiments suggest that predation rates depend primarily on urchin behavior, rather than predator abundance. These results elucidate the complexities of species interactions in these systems and caution against oversimplifying the role predators play in these subtidal communities. We hypothesize that the mechanisms leading to latitudinal variation in species interaction strength and type within the SCB involve site-specific levels of predator abundance, species composition, predator and prey species size, fishing pressure, and variation in oceanographic conditions.

75. PRENATAL DEVELOPMENTAL TOXICITY OF THE METHOXYCHLOR METABOLITE HYDROXYPHENYL-TRICHLOROETHANE IN C57BL/6 MICE

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Pesticides have been developed to improve commercial crop yields, but studies have shown that some organochlorine pesticides are endocrine disrupting chemicals (EDCs). EDCs have the ability to mimic, or block natural hormones, altering the normal functions of the body, including the immune system. This disruption of the immune system has been suggested to contribute to the development of autoimmune diseases in children, such as allergies and asthma. Since the EPA recognized the emerging health threat of EDCs and convened two international workshops in 1995 to determine the direction of future research, several studies have explored the impacts of EDCs. However, few of them have examined the effects of EDCs on the immune system (Daston, 2003). A goal of the current study was to observe the impact of EDCs on the development of the embryonic immune system in C57BL/6 mice. Methoxychlor (MXC) is one of the organochlorine pesticides found to have estrogenic effects, which led several countries to not relicense it for use (Stockholm Convention, 2004). Hydroxyphenyl-trichloroethane (HPTE) is a metabolite of MXC that has been shown to be even more estrogenic than MXC (Hu and Kupfer, 2002). Yet, few studies have looked at the effects of HPTE on the immune system. This study used an *in vitro* assay with concentrations of HPTE, starting within the EPA standards and titrated down in 10-fold dilutions from 50μM to 0.005μM, to observe its effects on T-cell differentiation in embryos at 16 to 18 days of gestation. At these physiologically realistic levels, we noticed a decrease in vitality and differentiated subpopulations in a dose dependent manner, which suggests that even at low concentrations, HPTE can be detrimental the development of T-cells.

76. BALLONA WETLANDS VEGETATION: HISTORICAL, CURRENT, AND APPLICATIONS FOR RESTORATION

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The Ballona Wetlands Ecological Reserve (BWER) is the largest opportunity for wetland restoration in the Santa Monica Bay and Los Angeles County. The Santa Monica Bay Restoration Commission (SMBRC) has been collecting baseline biological data at the BWER in Los Angeles, California, for several years. The project objective is to increase knowledge of the health and functioning of the BWER to inform an adaptive management and long-term restoration plan, while developing reproducible, scientifically valid regional wetland monitoring protocols.

The vegetation alliances of the BWER have undergone significant shifts in the past several decades, including massive impacts such as the development of Marina del Rey and the subsequent placement of fill on site in the late 1950's, and smaller scale events such as non-native plant invasions or community restoration efforts. The goal of this paper is to recognize some of the larger impacts, discuss shifts over time using current data, and to assist in the adaptive management planning of the restoration process. The current status of the vegetation was assessed using a stratified random sampling method; transects were randomly allocated within each of the habitat types at the BWER. Species level data were collected in addition to elevation and inundation information along the same transects.

Percent native cover was negatively correlated with elevation; percent non-native cover was positively correlated with elevation. Inundated areas had the lowest non-native cover. *Salicornia virginica* cover was also negatively correlated with elevation. Elevation, native cover, and non-native cover were significantly different between habitat types. Several of the marsh zones previously thought distinct may be similar based on vegetative cover. The implications of the results may help to reassess habitat zones and priorities for the marsh restoration.

77. SHIFTS IN HYDRAULIC AND MECHANICAL PROPERTIES OF STEM XYLEM DURING POST-FIRE RECOVERY OF THE CHAPARRAL SHRUB *HETEROMELES ARBUTIFOLIA*

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Most species of chaparral shrubs of California undergo vigorous resprouting after wildfire. We hypothesized that the water transport properties of stems, as well as their mechanical strength, would change during post-fire sprouting. We tested this hypothesis by using a centrifuge method to estimate the vulnerability of xylem to water stress induced cavitation (PLC_{50}) and a Universal Materials Testing Machine (Instron) to measure the modulus of rupture (MOR) and modulus of elasticity (MOE) in control, irrigated, and shaded resprouts compared to adults. Our experimental subject was *Heteromeles arbutifolia* (Toyon) that burned in the Malibu wildfire of 21 October 2007. Six months post-fire, resprout stems were more susceptible to cavitation than adults but mechanical strength of resprouts was significantly greater than adults. Irrigated resprouts had higher susceptibility to cavitation than the shaded resprouts and controls, but lower mechanical strength. The comparison of xylem vulnerability to cavitation between adult and control resprouts converged 1.5 years after fire but required an additional 0.5 years to converge in shaded and irrigation treatments. We conclude that stems from post-fire resprouts of *H. arbutifolia* have different water transport properties and mechanical strength than stems from adults and that these differences can be modified by artificial irrigation and shading. Shifts in cavitation resistance and mechanical strength suggest significant plasticity in xylem traits for *H. arbutifolia* and presumably represent adaptations that facilitate rapid shoot elongation and reestablishment in the post-fire environment.

78. THE EXTRA-OCULAR MUSCLES OF LAMNID SHARKS AS A POSSIBLE HEAT SOURCE FOR CRANIAL ENDOTHERMY

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Lamnid sharks have orbital *retia mirabilia* that conserve metabolic heat, allowing elevation of eye and brain temperatures above ambient water temperature (cranial endothermy). Warm blood from aerobic locomotor muscles transported to the orbital *retia* contribute heat, but an additional heat source is needed to maintain cranial temperatures at previously reported levels. We hypothesized that one or more of the extra-ocular muscles serves as a heat source for cranial endothermy in the shortfin mako shark (*Isurus oxyrinchus*). Eyes and extra-ocular muscles were dissected from sharks captured by long-lining during a juvenile shark abundance survey in the Southern California Bight. Mass (g) and specific activity of the mitochondrial enzyme citrate synthase (CS) were measured for each of the six extra-ocular muscles as an index of heat production capacity in *I. oxyrinchus*, and compared to values in the ectothermic blue shark (*Prionace glauca*). In *I. oxyrinchus*, the medial and lateral rectus were the largest extra-ocular muscles, but CS activity did not differ significantly among the six muscles. CS activity of only the medial rectus muscle was significantly greater in *I. oxyrinchus* than in *P. glauca*. As a percentage of total eye mass, all six extra-ocular muscles were larger in *I. oxyrinchus* than in *P. glauca*. Thus, muscle mass contributes more than CS activity to interspecific differences in heat production capacity. These results suggest that contraction of all six extra-ocular muscles may generate heat for cranial endothermy in *I. oxyrinchus*, with the medial and lateral rectus contributing a greater proportion of that heat.

79. HYPER-EFFICIENT WATER TRANSPORT IN C_4 GRASSES

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Grasses occupy an exceptional breadth of habitats and climates, and dominate in biomes accounting for 40% of the Earth's surface and > 25% of global net primary productivity. Much of this high performance is linked with the existence of C_3 and C_4 metabolism. The C_4 syndrome includes a CO_2 concentrating mechanism that allows minimal photorespiration and thus achievement of high light-saturated rate photosynthetic rates for a given stomatal conductance. These aspects of C_4 syndrome would especially provide benefits under low CO_2, and high temperature and irradiance, and potentially under atmospheric and soil drought. We used a comparative experimental approach to investigate the interrelationships of photosynthetic pathway, water relations and hydraulic architecture. Our results demonstrate a novel effect of the C_4 syndrome on the leaf water transport system. By contrast with C_3 species in which hydraulic supply and demand are coordinated, in C_4 species leaf hydraulic conductance is exceptionally high relative to stomatal conductance, conferring high hydraulic efficiency, and allowing sustained stomatal opening during the onset of soil and atmospheric drought. These findings provide a mechanistic basis for the contrasting physiological drought responses of C_3 and C_4 species. This hyper-efficiency of C_4 species, coupled with the correlation of hydraulic and stomatal traits with climate variables, supports the hypothesis that C_4 photosynthesis is an adaptation to high evaporation rates and limited soil moisture. Based on these data, we expect that C_4 species will be able to maintain their advantage over the C_3 type in future, high CO_2 environments if these are drier.

80. MACROPARASITES OF THE YELLOWFIN GOBY, *ACANTHOGOBIUS FLAVIMANUS* (PERCIFORMES: GOBIIDAE), FROM ITS INTRODUCED NORTHEASTERN PACIFIC RANGE

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The Yellowfin Goby, *Acanthogobius flavimanus*, is native to bays and estuaries along Japan, China, and the Korean Peninsula. It has been introduced, presumably via ship ballast water, to both northern and southern California coastal waters. Specimens from Tomales Bay in northern California and from the Cabrillo Salt Marsh (Salinas de San Pedro) in southern California were examined for external and internal macroparasites. None of the numerous native parasites reported for this host species from Asian waters were present in these California samples. However two local parasites, the cymothoid isopods, *Elthusa californica* and *Elthusa vulgaris*, were found to infect this introduced host and these are new host records for these generalist parasites. The reduction of parasitism is not unusual for successful introduced species and may be part of the reason for their success in a new habitat. The two isopod species were found together in the opercular cavity of one host specimen, which may be providing an opportunity for isopod hybridization.

81. PLACEMENT AND EARLY COMMUNITY DEVELOPMENT OF A NEW ARTIFICIAL REEF IN SANTA BARBARA COUNTY, CA

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In December 2005 a new offshore artificial reef was established at "Bird Island" in Santa Barbara County, CA. The reef was created from the abandonment of a 1930's era oil production pier remnant. A medium relief subtidal reef was created from large concrete pilings and covered with quarry rock over the abandoned oil production site. The reef lies approximately 900 feet offshore of the coastline in roughly 35 feet of water. The local shoreline and subtidal habitat is predominantly made up of sandy shores interspersed with natural rocky reefs. The subtidal rocky reefs and the sandy substrates support algal forests dominated by the giant kelp (*Macrocystis pyrifera*). The reef was designed to provide complex habitat that would support the establishment of communities of algae, invertebrates and fishes that would function similarly to the surrounding natural reef areas. The purpose of this ongoing study is to provide quantitative data on the successional changes in the establishment of the reef communities. The general study design is a paired-design time series in which data from benthic quadrats, band transects, and photo-transects are used to compare the Bird Island Reef communities to a nearby natural kelp reef. Data was collected during three periods throughout 2006. Initial data suggest that fish and invertebrate communities have become well established at the reef within the first year.

82. AN OPTICAL PROXY FOR ESTABLISHED BIOMARKERS IN BREAST ADENOCARCINOMA PATIENTS

Ayan Kusari. University High School, Dr. Albert Cerussi, Research Supervisor.

Immunohistochemistry (IHC), or antigen-based tissue staining, has played a key role in breast cancer diagnostics in recent years. Its great value has lay in its ability to classify and group breast cancer patients based the antigen markings of their tumors. These antigen markings often provide critical insight into altered cell metabolisms and even viable treatment options. However, IHC procedures are costly and slow, sometimes unacceptably so for late-stage breast cancer patients.

Because biomarkers such as those studied in this project—Ki67, HER2, PR and ER—play key roles in altering cell metabolism, their expression in cancer cells causes differential migration of small-molecule compounds known as chromophores. If chromophore values can be successfully correlated with biomarkers, they can serve as a fast, cheap, and useful optical proxy. Chromophores studied in this project include water, fat (which includes all forms of fatty acids), hemoglobin, and oxygen not bound to hemoglobin. Biomarker values were determined through IHC, and chromophore values were determined through optical spectroscopy using six photodiodes in the near-infrared range. Results were analyzed using in particular the Independent Samples T-Test, One-Way Analysis of Variance (ANOVA) with Levene's Test for Equality of Variances, and the Mann-Whitney Test. It was determined that the chromophores Oxyhemoglobin and Oxygen Saturation in particular could feasibly serve as proxies for PR, ER, and p53. It was demonstrated that it is possible to establish strong correlations between optical chromophores and immunohistochemical biomarkers, proof of concept of the gradual replacement of costly, slow, and painful procedure with a quick, easy, and noninvasive one.

83. TESTING AN ALGORITHM FOR RAPID DETERMINATION OF EARTHQUAKE RUPTURE CHARACTERISTICS FROM EARLY AFTERSHOCK DISTRIBUTIONS

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Aftershock locations may be used to determine reliable estimates of first-order earthquake rupture parameters more rapidly than may be obtained from full seismic waveform or geodetic inversions and field mapping. Because the spatial distribution of aftershocks for an earthquake sequence has a close empirical relation to its mainshock rupture extent, the epicentral locations of aftershocks can be used to delineate the entire mainshock rupture zone and to determine first- order parameters such as rupture length and orientation. An important goal of this research project is to determine how early in an aftershock sequence we can reliably and accurately determine these rupture parameters. To this end we test an algorithm we developed for rapid estimation of these parameters in a near real-time environment. The results of this algorithm may provide useful information to help quickly assess the impact (damage and fatalities) of large global earthquakes when incorporated in a global earthquake analysis system, such as implemented by the US Geological Survey National Earthquake Information Center. Required input parameters to this algorithm are limited to an earthquake catalog starting with the mainshock time and other fixed input parameters. Aftershock events are projected onto straight lines centered on the mainshock epicenter with a fixed incremental azimuth. Subsequently, a best fitting strike and rupture length for the mainshock fault are determined on the basis of this aftershock distribution. Our preliminary results indicate reliable estimates of fault rupture parameters may be obtained as early as one hour or less after the mainshock occurrence.

84. TAPHONOMY OF PIPESTONE SPRINGS, A MIDDLE CHADRONIAN MICROVERTEBRATE ASSEMBLAGE FROM SOUTHWESTERN MONTANA

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Pipestone Springs is an unusually rich concentration of well-preserved, small-bodied mammals. First discovered in 1899, the fauna includes over 40 species including numerous holotypes. Recent work yielded more than 2000 specimens, of which 70% were identified to element, 25% to taxon. Dentigerous elements include 493 specimens. Most common are small artiodactyls (29%), *Ischyromys* (25%), and *Paleolagus* (21%). By element, dentaries and maxillae (35%) are most abundant, followed by vertebrae (23%) and phalanges (10%). Ribs and partial skulls are rare. Coprolites are common and often contain highly fragmented bone. Puncture marks occur in about 20 mandibles. Fossils are widely dispersed throughout a thick volcanoclastic mudstone which indicates minimal hydraulic sorting. Over 98% of elements are from small (<34kg) sized mammals, a size selectivity that strongly suggests a predatory origin as does the presence of puncture wounds and bone-bearing coprolites. Assuming that post-mortem destructive processes prior to fossilization and during exhumation did not highly bias the content of the original prey assemblage, two predatory origins are plausible. First, the abundance, completeness, and preservation quality of fragile mammalian dental and postcranial elements suggest an avian origin, although an expected higher proportion of certain elements, especially ribs, are not seen. Second, occurrence of coprolites and puncture wounds, rarity of skulls, and high percentage of dental elements suggest a mammalian carnivore origin, although elemental damage associated with ingestion is absent. Thus, the Pipestone Springs assemblage has a taphonomic origin that reflects a primary source from mammalian carnivores, with lesser input from avian predators.

85. CATESTATIN: A REGULATORY PEPTIDE FOR FAT METABOLISM

Howon Lee. Torrey Pines H.S. ;RTP.

Catestatin (CST) is a peptide cleaved from the proprotein Chromogranin A and has been shown to control catecholamine production and blood pressure. Mice without the Chromogranin A gene(CHGA-KO mice) show high catecholamine concentration in blood and high blood pressure, which can both be

reversed by CST infusion, which suggests that the lack of the CST segment of Chromogranin A is responsible for hypertension and high catecholamine concentrations in KO mice. KO mice also demonstrate increased adipose tissue mass, which decreases after CST infusion, suggesting that CST might also regulate fat deposition and obesity. That observation, if established, will show a novel pathway for regulation of obesity by CST with therapeutic potential. This preliminary finding in the laboratory of Dr. Sushil Mahata at UCSD, that CST may regulate fat deposition, prompted this investigation to analyze the effects of CST on the metabolic responses of mouse adipose tissue and of adipocyte cultures.

Wild type and Chromogranin-KO mice were treated with CST and sacrificed by the sponsor. 3T3-L1 preadipocyte cultures were differentiated into adipocytes. Glycerol, non-esterified fatty acids(NEFA) and adiponectin were assayed with commercially available EIA kits.

While CST administration reduced plasma catecholamine concentration in KO mice, it enhanced glycerol release from the adipose tissue of those mice. Since catecholamines are known to increase glycerol release by stimulating lipolysis of triglycerides, this CST action was unusual.

CST administration reduced catecholamine levels and increased lipolysis, suggesting that the CST effect was not mediated by catecholamines. Also, contrary to expectations, the concentration of NEFA released decreased instead of increasing with glycerol released. In other words, CST treatment of fat cells did not stimulate NEFA release despite stimulating glycerol release. This finding was accounted for by the observation that CST profusely stimulated fatty acid oxidation in adipose tissue and much of the fatty acids produced by lipolysis were oxidized intracellularly, not released to the external medium. Furthermore, our observation that CST stimulated adiponectin production from adipocytes supported the notion that CST promotes fatty acid oxidation through activation of the adiponectin receptor-AMPK pathway.

By virtue of its interference with nicotine and catecholamine actions, CST has been proposed to act through the modulation of the functions of the nicotinic acid-acetylcholine receptor (nAChR) and the adrenergic receptors (AR) because nicotine activates nAChR, and catecholamines such as epinephrine, activate AR. Our investigation showed that, while CST suppresses the β-AR response, it stimulates adiponectin release from adipocytes through the activation of α-AR.

In conclusion, CST stimulated fatty acid oxidation via the activation of an adiponectin pathway and prevented re-esterification of glycerol into triglycerides in adipocytes, leading to the decrease in fat mass in adipose tissue. Further research would be needed to clarify how exactly CST prevents triglyceride formation and adiponectin production in adipocytes via α-AR.

86. INCIPIENT SPECIATION OF THE MUSTACHED BAT *PTERONOTUS PARNELLII* IN THE WEST INDIES

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Populations of mustached bat *Pteronotus parnellii* on Hispaniola (H), Puerto Rico (PR), and geographic intermediate Isla Mona (IM) were studied through molecular, morphological, and echolocation analyses to determine the species' population structure in the West Indies.

Phylogenetic analyses of cytochrome b sequences indicate H and PR *P. parnellii* group in largely exclusive clades while IM bats are genetically similar to PR *P. parnellii*. Fixed pairwise differences indicate high and significant separation values between H and PR as well as between H and IM. There is no significant difference between PR and IM and migration occurs mainly from PR to IM, much less so from H to IM. All other inter-island gene flow was negligible.

Comparisons using ANOVA showed that H *P. parnellii* is significantly smaller and lighter, with smaller forearms and feet but longer tails than PR bats. IM bats are morphologically similar to either H or IM, depending on the measurement. H bats emit a significantly higher frequency than PR/IM in the constant frequency portion of their echolocation call, corroborating the genetic data.

The results support classification of H *P. parnellii* population and the PR/IM population as separate species. Inter-island range expansion during the Wisconsinan glaciation followed by interglacial isolation is a possible incipient speciation mechanism. Determining this speciation event doubles the number of endemic species in Hispaniola, indicating the additional importance of conserving these species to maintain the full genetic diversity and population robustness of bats in the West Indies.

87. EXTRACTING RANGE FROM MONOCULAR TEXTURE FOR AUTONOMOUS ROBOT LOCALIZATION AND MAPPING

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Robotics capabilities have laid a heavy reliance on laser rangefinders to provide sensory data for spatial reasoning. These laser rangefinders, however, are extremely large, power-wasting, and costly for consumers. This project aimed at evaluating an image processing pipeline to extract rangefinder-like data from ordinary webcam images. The robot was based off a low-cost iRobot Create platform attached with webcam capabilities. Images are obtained through the OpenCV library and Python was utilized for core programming. After collecting initial training data, images are hand segmented and image patch data is placed in two approximate nearest neighbor classifiers. Novel images are then classified with patches indicating groundplane or obstacle. The image is then segmented based on the best transition area from groundplane to obstacle regions. From the segmented line, a range scan is computed based on an empirical model. Range scans are then utilized for autonomous localization within a known environment and mapping a novel environment. In all collected datasets, the classifier had a classification accuracy above 90 percent. Out of three segmenters, the transition line segmenter proved most accurate with a median range error of only 4.1 cm. This image processing pipeline will reduce the costs of robots without removing advanced capabilities.

88. THE EFFECTS OF THE PH INDICATOR, PHENOL RED, ON *IN VITRO* T CELL DIFFERENTIATION

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Phenol red, also known as phenolsulfonphthalein, is a bright red dye frequently used in cell culture media as a pH indicator. Since most cell cultures are set up to mimic environments in the body, which is usually a pH close to 7, phenol red is important as it monitors the pH of the environment in which cells are being cultured. Its color changes from red to yellow as the pH of the environment decreases. Phenol red is structurally similar to some nonsteroidal estrogens and therefore mimics estrogen when cells are exposed to it. It enhances the growth of cells and increases cell viability because it binds to the estrogen receptors on the surface of the cells and stimulates the proliferation of these estrogen receptors. Endocrine disrupting chemicals (EDCs) are synthetic organic compounds such as pesticides that disrupt normal hormonal actions in the body (in some cases by mimicking estrogen) and suppress the maturation and differentiation of T-cells in developing embryos. Since both phenol red and EDCs have similar effects on some cells, studies that examine the effects of EDCs on cells need to take into consideration the potential effects of phenol red. In this study, we seek to determine the extent of the effects of phenol red on the viability as well as differentiation of T-cells found in thymuses of embryonic mice. This is done by comparing the results of cells cultured in media without phenol red versus cells cultured in media with phenol red.

89. AN INVESTIGATION OF THE EFFECTS OF BISPHENOL-A ON THE DEVELOPMENT AND DIFFERENTIATION OF EMBRYONIC C57BL/6 MICE THYMOCYTES

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The immune system is composed of structures and processes that help defend and protect our bodies from pathogens. However, exposure to endocrine disruptors, chemical compounds capable of mimicking or blocking natural hormone pathways, can disrupt the normal function of the immune system. The alteration of immune function can lead to an increase in susceptibility to infectious diseases, and an increase in autoimmune diseases, such as allergies and asthma in children. Recently, a great concern has been raised regarding bisphenol A (BPA), an additive used to make polycarbonate plastic and epoxy resins, because it presents endocrine disrupting properties. Numerous studies have been performed to look

at the effects of BPA in the reproductive system and in the nervous system; however, few studies look at the effects on the developing embryo, in particular on embryonic T cell development. The aim of this study was to investigate the effects of BPA at a developmental stage on the different subpopulations of embryonic T cells. An *in vitro* assay was used to examine the development of T cells at different concentrations of BPA. Thymocytes were extracted from C57BL/6 mice embryos at 16 to 18 days of gestation. Our results indicate a decrease in thymocyte viability in a dose dependent manner, and effects on the different subpopulations. These findings suggest that BPA affects normal development and survival rate of embryonic T cells, which in part can have detrimental effects on the organism's immune system.

90. ORGANOCHLORINE CONTAMINANTS IN SOUTHERN CALIFORNIA MALE STINGRAYS (*UROBATIS HALLERI*) AND BIOCHEMICAL INDICATORS OF EXPOSURE TO PLANAR AROMATIC COMPOUNDS

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While contaminant concentrations have been reported for elasmobranchs around the world, very few have monitored levels for southern Californian species despite the high volume of industrial and residential inputs into the coastal environment. The round stingray (*Urobatis halleri*) is a local benthic species that forages near areas of high organochlorine contamination and is a good model to monitor contaminant accumulation and effects in elasmobranchs. PCBs, DDT (and metabolites), and chlordanes were measured in juvenile and adult male stingrays from areas in southern California. Organochlorine contaminants were extracted and cleaned via gel chromatography and analyzed using an Agilent gas chromatograph equipped with a mass selective detector. Juveniles and adults were found to have higher concentrations of PCBs (1,100±357 ng/g, ww) than chlordanes (92.23±49.78 ng/g, ww), or DDE (38.25±31.96 ng/g, ww). Preliminary data did not show significant differences in contaminant concentrations between juveniles and adults for any of the contaminants; however, there was high variability among individuals, which may be influenced by the round stingray's migratory patterns. Potential toxicity effects were explored through Western blotting and EROD activity assays of cytochrome P450 (CYP1A1) and compared to stingrays from a reference site (Santa Catalina Island). Stingrays collected from Seal Beach showed a higher expression of CYP1A1 than did Catalina Island rays. Our preliminary results suggest that PCBs and physiologically-related contaminants may be inducing a biological response. Therefore, round stingrays represent a suitable model for monitoring contaminant concentrations in local benthic elasmobranchs and use in future research exploring the physiological impacts of these contaminants.

91. MAPPING THE SUBSTRATE BINDING SITE OF A SERINE PROTEASE AUTOTRANSPORTER PROTEIN

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Serine Protease Autotransporters of Enterobacteriaceae (SPATEs) is a family of proteins secreted by pathogenic enteric bacteria through the autotransporter pathway. The 20+ SPATEs identified so far have been shown to be virulence factors. Despite a high degree of homology in their sequences the functions and substrates of SPATEs differ considerably. The SPATE model for our studies is Temperature-Sensitive Hemagglutinin (Tsh), which can function as a serine protease and an adhesin. In this study our goal is to map the substrate binding site for Tsh proteolytic activity. Since Tsh has not been crystallized, we utilized the crystal structure of another SPATE called Hbp. Tsh and Hbp differ by only two amino acids.

Superimposed crystal structures of α-chymotrypsin covalently bound to an inhibitor and the serine protease domain of Hbp helped identify three potential substrate binding site residues. A docking study conducted using a Tsh specific substrate identified one additional residue. Sequence alignment performed using Tsh and another autotransporter, Hap, for which the potential substrate binding site has been defined, further identified two additional residues. The six residues identified from these experiments were

mutated and the effect of mutations on the proteolytic function of Tsh was examined using Tsh specific substrates including mucin and a colorimetric oligopeptide. Both functional assays showed that mutating these six residues dramatically decreases the proteolytic activity of Tsh. This indicates the importance of these residues for the protein's proteolytic function and strongly suggests a role of these residues in forming the substrate binding site of Tsh.

92. ONE HEALTH: PEOPLE, ANIMALS, AND ENVIRONMENT

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New, emerging infectious diseases are arising at an alarming frequency. To thwart this public health problem, we need to understand where emerging diseases come from and why. New insights from metagenomics and comparative genomics provided the answer – most new human diseases are transmitted from animals, often following disruption of the environment. Although the health of humans, animals, and the environment are inextricably interconnected, practices in human and veterinary medicine and environmental impact rarely recognize these linkages. The "One Health" initiative integrates these three disciplines to develop upstream approaches to prevent disease.

93. EXPLORING THE MYRIAD ETIOLOGIC FACTORS OF XEROSTOMIA

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The etiology for the symptom of xerostomia (dry mouth) can be physiologic, pathologic, iatrogenic and idiopathic. The physiologic cause is due to aging and the associated atrophy of the secretory epithelial cells resulting in decreased formation of saliva. The pathologic causative factors include lesions that affect the acinar cells or the ductal system. In the autoimmune disease such as the sicca syndrome, the lymphocytes destroy the acinar cells resulting in dry mouth. Other examples include metabolic diseases such as diabetes mellitus. The iatrogenic causes include the administration of medications such as antihistamines, and chemotherapeutic drugs, and radiotherapy in the oro facial region, which causes destruction of the salivary gland tissue and the ensuing xerostomia. Sialography can be used to diagnose the sialoliths causing ductal blockage and the consequential xerostomia. After a thorough diagnostic investigation, if the clinician fails to identify the etiology, for academic purposes, the symptom of dry mouth is classified as 'idiopathic.' The sequel of this symptom is halitosis, the increased occurrence of dental caries, oral candidiasis, and discomfort which is exaggerated in denture wearers. The focus of treatment is primarily prevention and symptomatic to relieve the discomfort.

94. MALIGNANCIES IN THE ORO FACIAL REGION DUE TO ACTINIC EXPOSURE

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The paper addresses malignancies with actinic rays as the etiologic factor in the oro-facial area, a topic of interest to Southern Californians. Typically, the clinical picture is that of an ulcer that does not heal within two weeks. They arise from benign pre existing actinic keratosis. Basal cell carcinoma also referred to as rodent ulcer is a locally aggressive lesion that generally does not metastasize, and hence has good prognosis. The squamous cell carcinoma on the other hand metastasizes characteristically through the lymphatic vessels, initially to the regional lymph nodes, and later on wide spread to other areas of the body. Occurrence on the lower lip is more frequent, than on the upper, and as a rule has good prognosis due to early diagnosis, and microscopically the neoplastic cells are well differentiated with areas exhibiting keratin pearls. As is often the case, malignant melanoma metastasizes in the initial stages of the disease, with wide spread metastasis even at the time of diagnosis. The histopathologic examination reveals anaplastic /poorly differentiated malignant cells. Patients usually fail to seek early medical care in cases of amelanotic melanoma, as the lesion clinically is not pigmented. Treatment options include surgery, chemotherapy, and radiation. The prognosis depends on the clinical stage of the malignancy, and the differentiation of the neoplastic cells.

95. NEWLY DEVELOPED BORON-TITANIUM ALLOYS FOR HUMAN PROSTHETICS ARE LESS COLONIZED BY *STAPHYLOCOCCUS EPIDERMIDIS* THAN TRADITIONAL BIOMETALS, BUT MORE SUSCEPTIBLE TO *PSEUDOMONAS AERUGINOSA*

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Artificial human implants and prosthetics have been vital for physiological re-enforcement and reconstruction in many patients. The development of modern human prosthetics has resulted in more biocompatible implants, but they lack longevity due to prosthetic loosening caused by metal corrosion or microbial colonization. This susceptibility of biofilm formation on implants remains an important barrier to successful implantation. *Pseudomonas aeruginosa* and *Staphylococcus epidermidis* are two prominent bacteria responsible for patients' wound infections and biofilm formation. We investigated the biofilm susceptibility of new boron-titanium alloys, stainless steel (SS), commercially pure titanium (CPTi), and Ti-6Al-4V (Ti64) to both these microbes. To determine the amount of biofilm growth, we performed crystal violet staining. Utilizing a biofilm reactor, metal disks of each alloy composition were exposed to 350ml of bacterial culture in TSB media for 48 hours at 37°C.

Results show that titanium alloys with 0.05% boron and 0.4% boron incorporated permit less biofilm formation by *Staphylococcus epidermidis*. However, the incorporation of boron into titanium alloys does not seem to inhibit biofilm formation by *Pseudomonas aeruginosa*. In order to characterize the viability of the cells comprising the biofilm, we used the LIVE/DEAD® BacLight™ Bacterial Viability Kit and fluorescent microscopy. It is observed that within 48 hrs, bacterial colonization is organized into large biofilm structures on traditional biometal surfaces (SS, CPTi), but in smaller, uniform colonization patterns on boron-titanium alloys. Indicating that microbes may be more susceptible to antibiotic treatment in patients with boron-titanium alloys, since large biofilm structures protect bacteria from antibiotic treatments.

96. "SURF, SAND, AND SILVERSIDES: THE CALIFORNIA GRUNION"

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"Surf, Sand, and Silversides: The California Grunion" is a new educational video that shows the challenges and wonder of spectacular midnight spawning runs for an endemic marine fish. California Grunion, *Leuresthes tenuis*, surf in by the thousands onto California's sandy beaches for midnight rendezvous. New discoveries and images of the grunion life cycle, early development, and ecology are revealed, along with human impacts on the runs and nesting areas. These charismatic fish inspired a group of citizen scientists, the Grunion Greeters, to find new ways to balance human recreation and wildlife conservation on many of California's most urban beaches. With the cooperation of local citizens, government agencies, environmentalists, and scientists, changes have been made in beach management. Scenes were shot on location at more than a dozen different beaches along the California coast from San Diego to Santa Barbara. Support was provided by the National Oceanic and Atmospheric Administration, California Coastal Commission, National Marine Fisheries Service, National Geographic Society, Coastal America Foundation, and Pepperdine University.

97. OLIGOTHIOPHENE LIQUID CRYSTALS FOR PHOTOVOLTAICS

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Liquid crystals (LCs) are organic materials that possess some degree of order typically associated with crystalline solids while retaining the fluidity of a liquid. Smectic LCs self-organize into layers maintaining both directional and positional order. Organic semiconductors are receiving increased attention due to their potential application in electronic devices such as light-emitting diodes (OLEDs), field effect transistors (OFETs), and photovoltaics (OPVs). These semiconductors utilize intermolecular π interactions to transfer charges in an applied electric field. The higher the molecular order of the organic

semiconductor, the better the charge transport. Smectic phases are advantageous for charge transport due to the 2-dimensional layered arrangements of close-packed polyaromatic moieties. Oligothiophenes are well known as some of the most promising of semiconductive organic compounds. Our current efforts include the synthesis of oligothiophene-based smectic LCs. 2,2′-bithiophene was acylated in the 2 position to yield 2-decoyl bithiophene. The ketone was reduced with sodium borohydride to the alcohol. 2-decoyl bithiophene was also iodinated in the 2′ position with N-iodosuccinimide. 1-hexyne was added to 2-decoyl bithiophene with sonagoshira coupling. 2,2′-bithiophene was acylated to yield 2-ethoyl bithiophene under Friedel-Crafts conditions and subsequently iodinated with N-iodosuccinimide. Resulting methyl ketones have been successfully converted to carboxylic acids with iodine in pyridine. Ullmann-type homocoupling of iodo-acylbithiophenes facilitates the synthesis of symmetric quaterthiophene dicarboxylic acids, which will be esterified.

98. FINE-SCALE HORIZONTAL AND VERTICAL MOVEMENTS OF BARRED SAND BASS, *PARALABRAX NEBULIFER*, WITHIN A KNOWN SPAWNING AGGREGATION

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Active acoustic telemetry was used to quantify movement patterns of barred sand bass within one known spawning aggregation location, the Huntington Beach Flats, California. Individuals tagged with either Vemco V13 pingers or V13P depth sensors were actively tracked over multiple nonconsecutive 24 hr periods. Individuals displayed distinct diel patterns of activity and significant day-to-day variation, which may be indicative of spawning periodicity or frequency. Daily activity spaces averaged 0.21 km^2 in size (range 0.002–1.89 km^2) and were significantly larger during the day than at night. Fish displaying presumed spawning behaviors were found over sand more often than reef habitat and used significantly larger activity spaces (mean = 0.31 km^2, range 0.005–1.89 km^2) than non-spawning fish (mean = 0.011 km^2, range 0.002–0.036 km^2). These animals remained approximately 3.6 ± 4.3 m (± SD) off the seafloor at night and moved up into the mid-water column (8.3 ± 6.0 m off substratum) during the day remaining primarily within or just below the thermocline (~ 16 °C). During the day, they continually made directed dives towards the seafloor lasting 15–30 sec; a behavior believed to be analogous to vertical spawning rushes demonstrated by other serranids. Non-spawning individuals were associated with reef structures and remained on average 2.5 ± 2.3 m off the seafloor throughout both day and night periods. Understanding barred sand bass spawning habitat utilization and characteristic spawning behaviors may lead to more effective management strategies for this species and protect the long-term sustainability of the fishery.

99. THE EVOLUTION OF SENDAI VIRUS FROM A PNEUMOTROPIC TO A PANTROPIC VARIANT

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Sendai virus is a negative-stranded RNA virus that causes a respiratory tract (pneumotropic) infection in mice and serves as a model organism for studying similar infections in humans such as those caused by influenza virus. F1-R, a variant of Sendai virus causes a systemic (pantropic) infection in mice. Sequencing revealed that F1-R has ten mutations that lead to amino acid changes in the viral proteins. Our goal was to identify which of those mutations were critical for the pantropic phenotype of F1-R. We identified two determinants that we hypothesized were crucial for F1-R to cause a systemic infection. The first determinant was the enhanced cleavability of the fusion (F) protein that we attributed to one or more of the six mutations in the F gene of F1-R. Cleavage of F is required for viral infectivity. The second determinant was the bipolar budding of the virus that we attributed to the two mutations in the matrix (M) gene of the F1-R. Bipolar budding of F1-R results in some virus being released into the basement membrane of the infected cell through with it can gain quick access to the bloodstream for dissemination. To prove our hypothesis we used reverse genetics to make viruses with various combinations of the F and M gene mutations of F1-R. Only RGV0, a virus containing all F1-R F and M gene mutations, caused a

systemic infection providing proof that mutations in the M and F genes of F1-R are sufficient to convert F1-R into a pantropic virus.

100. 1CLIMATE-DRIVEN CHANGES IN SOUTHERN CALIFORNIA COASTAL FISHES, 1972–2009

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Global, oceanic, capture fisheries are declining, but little information is available on the status of coastal, minimally-harvested species. We used a novel, 38 year (1972–2009) time-series of coastal fish abundance estimates recorded during entrapment monitoring at five coastal power plants that utilize once-through-cooling to study variations in species-specific trends. This time series encompassed ~170 km of the Southern California coastline and large-scale, low-frequency oceanographic variations including a long-term warming trend. Twenty-one species make up 98% of the 13 million fish recorded. The ensemble mean, annual entrapment rate declined 95% from 1972 ($693/10^6$ $m^3 \pm 327$, SE) to 2009 ($34/10^6$ $m^3 \pm 10$). These data document a marked decline in abundances and a faunal shift, in close association with ocean warming. The first principal component (PC1) accounted for 29% of the variation and was significantly correlated with SST ($R^2 = 0.51$). Annual PC1 scores further indicate a transition from a cold regime to a warm regime separated by a ~decade-long transitional period from 1976–1986. The regime designations were made based on the community composition and their species-specific relationships with each other and SST. Percent similarity index (PSI) analysis revealed a shift from a relatively stable PSI to a highly variable PSI in the late-1990s. PSI by years separating the survey indicated a rapid decay in similarity between years ultimately reaching an asymptote at circa 10 years separation. The limited capture fishery importance suggests these patterns of change are due to effects of environmental dynamics rather than harvesting.

101. EXCITATION – EMISSION MATRIX IMAGING INSTRUMENT

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The purpose of this research project is to design and assemble a new fluorescence imaging spectroscope that will allow analyzing multiple fluorophores in the sample simultaneously with higher resolution in an efficient amount of time. Prior to instrumental modeling, theoretical calculations and analysis were carried out using preexisting excitation and emission data information obtained from PhotochemCAD. The results of the theoretical calculations indicated that the simultaneous analysis of complex mixtures of multiple fluorophores with probable overlaps of their emission spectrums will be possible to resolve and identify the presence of each fluorophores. The instrumental modeling was carried out by designing the light source consisting of specific LED-array through use of FRED optical engineering software, a programmable microprocessor with digital output capability, Arduino Control board, was utilized to control the LED lighting patterns, also, the EEM imaging instrument was completely designed via the 3D mechanical CAD program, Solidworks 2009.

102. SIGNIFICANCE OF FOOD ENERGY ON HEAD SIZE IN MALE HOUSE CRICKETS

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Sexual dimorphism exists among many animal species as a way to increase gender specific fitness. A common male fitness strategy is the ability to fight other males who invade their territory or steal potential mates. Fighting can be improved with sexual dimorphic traits that produce weapons, such as large antlers on male dear, *Capreolus capreolus* (Hoem, C. 2007), or leg armature in spiders, *Arachnida opiliones* (Willemart, RH. et al. 2009). In the case of house crickets, *Acheta domesticus*, fighting is improved by a larger head size (Walker, S. 2008). Since it was already known that a large head was a beneficial weapon to male *Acheta domesiticus*, a new question was generated: "Is the energy in food spent on increasing male head size?" To answer this question, 100 fourth instar crickets were isolated in individual containers. Fifty

control crickets were fed an ad libitum diet of cat chow (~ 0.5g), while 50 starved crickets were fed only 0.062g–0.089g. The mass of eaten food was calculated every two weeks to confirm that the control crickets ate more than the starved crickets. The mass of the crickets as well as mandible and eye midpoint lengths were calculated once the crickets reached their mature stage. The control crickets ate, on average, 30 mg more food per week than the starved crickets. Although the control crickets had slightly larger mandible lengths, there was no significant difference between mandible length ($p = 0.13$) or eye midpoint length ($p = .096$) between the control and starved crickets.

103. CATCH SHARES: REVOLUTIONARY OR EVOLUTIONARY FISHERIES MANAGEMENT?

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NOAA's Catch Share Policy 2010, a policy to set forth the agency's support for a new wave of thinking about fisheries management or just another tweak to the system to fit a previously unfilled regulatory niche? On the brink of the policy's release, the NOAA Southwest Region Sustainable Fisheries Division held a workshop with academic leaders and fishery constituents to discuss the potential role of catch share management for West Coast Coastal Pelagic fisheries. Rooted in economic and institutional theory, catch shares are regarded by academic theorists as revolutionary, incentive-based policies that set fisheries operations and management on a new trajectory, one where efficiency is highly valued and decision-making about the fish stocks is decentralized and inclusive of all fisheries stakeholders. For practitioners, catch shares are a clear departure from more traditional approaches used to regulate fisheries; however, their ability to address more recent challenges in fisheries would suggest that they are yet another stage in the evolutionary process of management. For fishery constituents, anticipating pros and cons of catch shares has proven a context-laden activity where the unknowns of change are generally worrisome.

104. UNVEILING THE MECHANISMS FOR DECREASED GSH IN INDIVIDUALS WITH HIV INFECTION

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Worldwide, it is estimated that approximately 40 million people are infected with HIV, two-thirds of whom live in sub-Saharan Africa. AIDS is the fourth leading cause of death worldwide. People diagnosed with AIDS often suffer from life-threatening diseases caused by opportunistic infections including tuberculosis (TB). In recent years there has been a significant increase in the incidence of TB due to the emergence of multi-drug and extreme-drug resistant strains *of Mycobacterium tuberculosis* (*M. tb*) and due to increased numbers of highly susceptible immuno-compromised individuals arising from the AIDS pandemic. It is also believed that in developing countries, as many as 40 to 80% of individuals with AIDS are at risk of developing TB. Our group has reported that the virulent strain of *M. tb* is sensitive to glutathione (GSH). In this study, we examined the causes for decreased GSH in individuals with HIV infection. We observed increased levels of free radicals, IL-1 and TGF-β in plasma samples derived from individuals with HIV infection compared to healthy subjects. The increased levels of free radicals, TGF-β and IL-1 correlated with decreased levels of GSH in natural killer cells and T cells derived from HIV positive individuals. To summarize, increased levels of free radicals in individuals with HIV infection will in turn enhance the synthesis of TGF-β and IL-1. TGF-β inhibits the expression of γ-glutamyl cysteinyl ligase (γGCL, a rate limiting enzyme involved in the synthesis of GSH) and IL-1 augments the efflux of cysteine from the cells. Decreased intracellular levels of cysteine in conjunction with concomitant reduction in the expression and activity of γGCL will result in decreased levels of GSH resulting in increased susceptibility to *M. tb* infection.

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105. HUMAN MITOCHONDRIAL DNA FROM 13TH CENTURY BCE, TALL AL 'UMAYRI, JORDAN SHOWS HAPLOTYPE INTERMIXING

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Archaeologists in Tall al 'Umayri, Jordan, discovered human bone fragments in a destruction layer from at least four human individuals (two adults, one adolescent and one child). The destruction layer was dated to the Late Bronze/Early Iron I period (13th century BCE) . ^{14}C dating on two samples from one arm bone yielded ages between 2940±15 and 2930±15 calibrated years BCE for each sampling. Ancient DNA (aDNA) was extracted from three individuals (jaw bone of an adult male, tooth of an adult, and bone fragments). Parts of the human mitochondrion genome D-loop were amplified, however, no nuclear DNA was recovered. The mtDNA was sequenced and aligned against multiple human mtDNA samples including *Homo sapiens sapiens* and *Homo sapiens neanderthalensis*. Preliminary analysis of informative polymorphisms in the first (HRVI) and second (HRVII) mtDNA hypervariable regions show haplotypes associated with the Middle East, North Africa and Europe. Among these were markers associated with the haplogroups L, U, D, M and X. This variety of haplotypes is significant because it is consistent with migratory intermixing expected from upheavals in the Eastern Mediterranean in the 13th Century BCE.

106. THE EFFECTIVENESS OF UTILIZING FISHWATCH IN PROMOTING CONSUMPTION OF SUSTAINABLE CALIFORNIA SEAFOOD IN RESTAURANTS, RESORTS, AND CRUISE LINES OPERATING IN SOUTHERN CALIFORNIA

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The launch of FishWatch and the subsequent re-launch of "FishWatch 2.0" has had a dramatic effect in promoting the consumption of sustainable California Seafood among the largest restaurants, resorts, and cruise lines operating in Southern California. FishWatch has enabled sustainable seafood program developers, like myself and the Aquarium of the Pacific's Seafood for the Future program, to easily share fact-based, unbiased, accessible data on the state of California's fisheries with Purchasers, Chefs, and even the diners they serve. This presentation will explore the tools I've developed utilizing FishWatch and their effectiveness. One marked increase that will be discussed is the use of California Halibut *Hippoglossus stenolepis* and California White Sea Bass *Cynoscion nobilis* which has increased over 100% since FishWatch has been incorporated into City Sea Foods' Sustainable Seafood Program. The presentation will go on to discuss ways in which we can expand these effects.

107. MEASURING XYLEM VULNERABILITY CURVE

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In the Mediterranean climate of California, citrus plantations have high irrigation demands. During water shortages, a better understanding of drought tolerance mechanisms in citrus could allow for water conservation by deficit irrigation management. To address physiological mechanisms of drought resistance in citrus, the vulnerability of citrus to form xylem embolisms was investigated. Under drought condition, the xylem and the plants' hydraulic system can draw in air to create air bubbles (embolism) that impede water flow. The purpose of this study was to document xylem vulnerability of three citrus species: *Citrus x sinensis* (Valencia Orange), *Citrus x paradisi* (Grapefruit), and *Citrus x reticulata* (Tangerine). Four methods were compared to determine the best technique for hydrating the stems for determination of maximum hydraulic conductivity when the xylem is completely filled with water. These included (1) high pressure flushing for one hour at room temperature, and (2) low pressure flushing at 12°C for 16 hours, (3) a one-hour vacuum treatment of submerged stems followed by high pressure flushing for one hour at room

temperature, and (4) a 16-hour vacuum treatment of submerged stems at room temperature. High-pressure flushing, the widely used standard method, was found to produce the lowest hydraulic conductivity and long-term vacuum and long-term low pressure flushing both caused the highest hydraulic conductivities. The vacuum treatment, being the easier of these two to implement, was adopted as the method of choice. Stems longer than the longest vessel were subjected to the vacuum treatment and their xylem vulnerability determined using an air-injection method.

108. ANTIFUNGAL EFFECTS OF COMBINING NON-DRUG CONTAINING LIPOSOMES WITH AMPHOTERICIN B LIPOSOMES

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Introduction: Antifungal drugs, e.g. liposomal amphotericin B (AmBisome®), are used to kill fungi that cause life-threatening infections but the immune response of the body to the fungus is also needed to help resolve the infection. *Aspergillus flavus* and *Aspergillus fumigatus* infections often occur in immunocompromised patients. Immunostimulating agents, such as non-drug containing liposomes (ndL), have been shown to help clear fungal infections in immunocompromised animals. We used microtiter broth assays to address the question of the antifungal activity of ndLs.

Methods: *In vitro* microtiter broth assays were used to determine the minimal amount of drug needed to inhibit (MIC) and kill (MFC) *A. fumigatus* and *A. flavus*. We tested AmBisome, ndLs and the combination of AmBisome and ndLs. We used 96 well microtiter plates with 1.7–3.8 $\times 10/\backslash 3$ spores per well (*A. flavus*) or 1.7–9.3$\times 10/\backslash 3$ spores/well (*A. fumigatus*).

Results: From several replicates of the microtiter broth assay, we determined that for *A. flavus,* the AmBisome MIC was from 0.78–3.1ug/ml. When AmBisome was combined with ndLs, the MIC was 1.56ug/ml. For *A. fumigatus*, the MIC was from 0.58–2.34ug/ml. With the combination of AmBisome and ndLs, the MIC was also 0.58–2.34ug/ml. The AmBisome MFC for *A. fumigatus* was between 0.97–1.93ug/ml and for AmBisome plus ndLs, it was 2.3–3.9ug/ml. This showed that the ndLs had little to no effect on the antifungal activity of AmBisome for *A. fumigatus*. The ndLs alone had no antifungal activity against either fungus.

Conclusions: The absence of any direct antifungal activity by the ndLs in the microtiter assay indicates that combining AmBisome and ndLs does not interfere with AmBisome antifungal activity. For our future studies we will work with macrophages *in vitro* incubating them with fungal spores, AmBisome and ndLs to determine the antifungal and immunomodulating effects of these agents on infected macrophages.

109. WATER SUPPLY AND DEMAND FOR LEAVES OF TWO TANK BROMELIADS

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The leaves of tank-forming bromeliads are unusual in that they are both photosynthesizing and absorbing organs. Because roots of most tank bromeliads provide anchorage only, water uptake is performed by leaf bases submerged in tank water. We investigated leaf properties related to water uptake and use by two tank bromeliads, the CAM species *Aechmea nudicaulis* and a cultivar of a C3 species, *Vriesea* cv. "Tiffany" grown in a glasshouse at Occidental College. Although the CAM species might be expected to be more conservative in its water use than C3 species, it also occurs higher in the canopy (in higher light) than do species related to *Vriesea*, thus demands on the hydraulic supply system of *A. nudicaulis* are expected to be higher. In line with this prediction, leaves of *A. nudicaulis* had 20% more vascular bundles than *Vriesea*, with a mean of 6.0 tracheids per bundle as opposed to 2.1 for *Vriesea*, although there was no difference in tracheid diameter (6.0 $\pm$ 0.0003 vs. 6.1 $\pm$ 0.0003 μm, $P = 0.75$). On a whole plant basis, *A. nudicaulis* had only 1/3 as much transpiring leaf area as *Vriesea*, but its ratio of absorbing leaf area (area of leaf bases in tank water) per transpiring leaf area was twice as great (0.74 as opposed to 0.32). The greater investment in absorbing leaf area supports a more conservative use of water for *A. nudicaulis*, yet its vascular tissue has greater capacity for delivery, in keeping with its higher position in the canopy.

110. ACQUISITION OF INTESTINAL ENDOPARASITES IN JUVENILE SPECKLED SANDDABS, *CITHARICHTHYS STIGMAEUS*

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We examined the endoparasite communities of 60 *Citharichthys stigmaeus* obtained from Campbell Cove in Bodega Bay, CA. The 60 host fish could be divided into two size classes approximately corresponding to young-of-the-year (standard length <60 mm) and one-year age classes (>60 mm). Twenty-six of the 60 fish were infected by some endoparasites (prevalence: 0.433). Two groups of endoparasites were discovered: cestodes at 0.3 prevalence and trematodes at 0.20 prevalence. A comparison of cestode prevalence shows no significant difference between large and small size classes ($P = 1.000$), but a comparison of trematode prevalence between size classes was significant ($P = 0.016$). Speckled sanddabs begin to acquire endoparasites in their very first year of life.

111. COAST LIVE OAK (*QUERCUS AGRIFOLIA*) RECRUITMENT AND GROWTH DYNAMICS IN THE FOOTHILLS OF THE SAN GABRIEL MOUNTAINS

M R. O'Neill and Dr. R.D. Quinn. Department of Biological Sciences, California State Polytechnic University, Pomona, CA, 91768.

As urban development encroaches on native habitat and sudden oak death syndrome increases mortality, an understanding of recruitment and growth dynamics has become crucial to effective management and restoration initiatives for coast live oak (*Quercus agrifolia*) woodlands. By establishing the age structure of a natural stand we sought to determine whether adults present were recruited in large numbers in a synchronous manner reflective of rare events, or more frequently but in fewer numbers. Standard dendrochronological techniques, coring and trunk cross sectioning, were employed in concert with morphological measures to identify significant predictors of age, growth patterns through time and stand age composition. Our analyses identified average crown spread as the most accurate morphological predictor of age, and confirmed the slightly less accurate predictive ability of the traditional metric, DBH. Secondary growth patterns were found to vary within individuals through time, but did not differ at the population level. The pattern of recruitment was variable in time, but was generally consistent with the few but frequent successful offspring hypothesis. The analysis suggests that the growth patterns among individuals vary with historical and environmental factors, while recruitment is a product of periodic gap formation and competitive release.

112. MIMICRY IN *NAVANAX* SPECIES FOUND IN THE EASTERN PACIFIC

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Navanax aenigmaticus (Mollusca: Opisthobranchia: Aglajidae) is found in three costal regions: the eastern Atlantic, the Caribbean, and the eastern Pacific. Generally speaking, specimens from each region are morphologically indistinguishable and share a common coloration. Their coloration is usually white striations against a dark background, with blue and orange dots alternating along the edge of the parapodia. However, some specimens found in Baja California, which is its northernmost range in the eastern Pacific, differ in their coloration. This pattern consists of a random distribution of white, blue, and orange spots against a dark background. Their coloration more closely resembles other highly spotted marine species found within the same region, which includes other opisthobranch sea slugs and flatworms.

Navanax inermis, a related species found only in the eastern Pacific, also shares this color pattern in specimens found in Baja California. *N. aenigmaticus* resembles *N. inermis* so closely that they are best distinguished using molecular methods. All of the opisthobranch sea slugs sharing this coloration are highly toxic. It is unknown if the other marine species with this coloration also possess toxins or if they are benefiting from shared coloration as a defense mechanism against potential predators.

113. VOLUMETRIC ANALYSIS AND FUNCTIONAL MORPHOLOGY OF THE AGNOSTID TRILOBITE *PSEUDAGNOSTUS* AT A LATE CAMBRIAN EXTINCTION BOUNDARY

Ray Ostrander and Linda Ritterbush, Ph. D. Swenson Summer Research Fellowship, California Lutheran University, Department of Geology, Thousand Oaks, CA, 91360.

This investigation utilized volumetrics of agnostid trilobites to analyze the potential ecologic advantage of inflated pygidia, a major morphologic distinction of Late Cambrian Agnostina, including those that persist across extinction boundaries. Using Z-stacking digital microscopy, we acquired direct morphometric data, including hitherto fore unavailable volumetrics, for pygidia of 14 agnostid trilobites from field collections from Late Cambrian sections in Eastern Nevada and Western Utah.

Carbon isotope curves show a large excursion during the Late Cambrian, indicating that fluctuating oxygen concentrations were a significant environmental challenge for trilobites. Because subcylindrical extensions on agnostid appendages, known from phosphatized specimens in the Swedish Orsten, are widely regarded as oxygen-absorption structures, we compared our volumetric data with estimated spatial requirements for such oxygen-related structures, assuming the extrapolation of known allometric growth of the extensions. We hypothesize that increasing pygidial volume in species of *Pseudagnostus* known to persist across an extinction boundary (the Steptoean/Sunwaptan Stage Boundary or the Ptychaspid/ Pterocephalid Biomere Boundary) conferred an adaptive advantage in the fluctuating oxygen regimes of the Late Cambrian, as compared to other agnostids, because of the resultant greater accommodation of subcylindrical limb extensions.

114. OVARIAN DEVELOPMENT IN THE BLACK WIDOW SPIDER

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Over the course of their life, black widow spiders (*Latrodectus hesperus*) have the potential to generate multiple egg sacs containing hundreds of eggs over a period of several months often from a single copulation. This feat can only be accomplished if there is a steady supply of oocytes. In this study, ovarian tissue was isolated from black widow spiders at different stages of oocyte development. Oocytes attach to the ovarian wall by a multicellular funiculus and project into the abdominal space. Oocytes at all developmental stages co-exist on the spider's ovary wall. Previtellogenic oocytes are characterized by diffuse cytoplasm with numerous mitochondria. During vitellogenesis the oocytes increase in size with the accumulation of yolk granules. The number and size of the yolk granules change over time. In the gravid spider, oocytes have separated from the wall of the ovary and are loosely aggregated within the abdomen of the spider. Following oviposition, the oocytes become surrounded by a harden shell composed of small spherical granules. The pattern of ovarian development in the black widow spider is similar to that documented in other spiders. It remains unclear how the mature oocytes move out of the abdominal cavity.

115. FACTORS DETERMINING MORTALITY OF ADULT CHAPARRAL SHRUBS IN AN EXTREME DROUGHT YEAR

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To determine whether isohydric or anisohydric species were more vulnerable to extreme drought, we examined a chaparral shrub community in southern California along an ecotone with a Sonoran Desert community that had experienced widespread drought-induced dieback of adults. Comparisons of dieback were made among seven co-dominant shrub species to relate mortality to post-fire regeneration strategy (sprouters compared to non-sprouters), specific leaf area (SLA), seasonal low water potentials, and resistance of stems to drought-induced xylem cavitation. The hypothesis was that more isohydric chaparral species would show greater dieback and adult mortality. Species with higher field water

potentials were considered more isohydric. Contrary to predictions, dieback and mortality were higher in the non-sprouting, more anisohydric species. In addition, the mortality was greater in the more anisohydric *Adenostoma fasciculatum* than in the more isohydric congener *A. sparsifolium,* both of which are sprouting species. Apparently the more isohydric species, although more vulnerable to xylem cavitation and with greater SLA, are deeper rooted and thus could access sufficient water resources even during the prolonged drought, preventing catastrophic xylem cavitation or carbon starvation. An exception was *Bernardia myricifolia,* which was highly anisohydric, but exhibited drought deciduous behavior to survive severe drought. Thus, to predict adult plant mortality at chaparral/desert ecotones, rooting depth and leaf abscission are key traits in addition to stomatal behavior, SLA, and resistance to xylem cavitation.

116. THE EFFECT OF FLOWER ABUNDANCE AND MORPHOLOGY ON PLANT-POLINATOR INTERACTIONS IN ALPINE MEADOWS

Erica Pandolfi, Dr. Martina Stang, and Dr. Ruben Alarcon. California State University Channel Islands Rocky Mountain Biological Laboratory. Gothic, Colorado.

In a community of plants and pollinators, their interactions are organized into complex, organized networks of repeated patterns. The identification of these patterns is important to the conservation of both individual species, and entire communities of plant-pollinator webs. We studied the effect of flower morphology and abundance on the visitations seen in an alpine community. The traits we examined were: nectar tube depth, nectar tube width, and flower size. Nectar tube depth was significantly related to the number of visitor species that a flower species received. It was found that the abundance of the flower was not related the number of visitor species that flowers received. The mean values for the proboscis lengths and nectar tube depths were taken, and constructed into a potential matrix, displaying the possible interactions between flower and visitor species, and into an actual matrix, which listed the observed interactions between each species. The number of different species visiting each flower species was totaled in potential and actual matrices. A correlation of these values revealed a significantly positive correlation. The discovery of the reasons behind the complex visitation web illuminates individual patterns and therefore histories of coevolution

117. THE MARINE LIVE BAIT TRADE IN SOUTHERN CALIFORNIA: A PATHWAY FOR INTRODUCTION OF NON-INDIGENOUS SPECIES OF PARASITES?

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Several species of non-indigenous marine invertebrates are regularly imported into southern California for use as live bait in recreational fishing. These species have the potential to become invasive and to negatively affect existing southern California marine communities. Besides target species, hitchhikers and parasites are also found in shipments of live bait. In this study, we assessed the likelihood of importing parasites infecting marine live bait, using the trade in ghost shrimp (*Neotrypaea* spp.) as a model. *Neotrypaea* spp. are native to southern California, but specimens sold in bait shops in California are imported from Oregon and Washington and may be infected with non-indigenous species of parasites. We inspected imported ghost shrimp to determine what species of parasites are imported with them and also inspected field populations along the west coast of the United States to determine if parasites infecting imported ghost shrimp are native or non-indigenous to southern California. At least three parasites infect *Neotrypaea* spp. on the west coast of the United States: the cestode *Prochristianella* sp., the nematode *Ascarophis* sp., and the bopyrid isopod *Ione cornuta. Prochristianella* sp. was not observed infecting imported ghost shrimp. *Ascarophis* sp. and *Ione cornuta* were found infecting imported ghost shrimp at a prevalence of 3.5% and 14%, respectively. In field populations, *Prochristianella* sp. was only found in southern populations of ghost shrimp. *Ascarophis* sp. was observed in every collection site and is likely to be native to southern California. While the introduction of *Ascarophis* sp. does not seem to be a reason for concern at this point, the introduction of *I. cornuta* merits further investigation.

I. cornuta was found primarily in sites north of Point Conception. However, this study reports for the first time *I. cornuta* infecting ghost shrimp populations south of Point Conception, which suggests that this

species may be non-indigenous to southern California. *I. cornuta* is a parasitic castrator and may negatively affect ghost shrimp populations in southern California.

118. FIELD RESEARCH AT CABRILLO MARINE AQUARIUM: INNER CABRILLO BEACH SURVEY

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Research at Cabrillo Marine Aquarium (CMA) consists of staff, volunteer, and student projects in both long-term monitoring of local marine habitats and laboratory-based husbandry projects. Currently, CMA is conducting a long-term monitoring project on Inner Cabrillo Beach called the Inner Cabrillo Beach Survey. The Port of Los Angeles (POLA) and other City of Los Angeles agencies have collaborated to identify potential causes of chronically high bacteria levels at Inner Cabrillo Beach. As an attempt to increase water flow and therefore reduce bacterial levels, fine-grained sand was replaced with coarser sand in the upper portion of the beach in spring of 2007 and down into the intertidal in spring 2009. The Inner Cabrillo Beach Survey began in 2006 as a way to determine if the sand replenishment project affected the local marine fauna. This project has evolved into a long-term monitoring study of the species diversity and abundance of fishes and invertebrates living in eelgrass beds of Inner Cabrillo Beach. Since the inception of this project, approximately 45 species of fishes and 30 species of invertebrates have been collected and identified. The dataset will continue to grow with routine monitoring conducted at three locations on Inner Cabrillo Beach, three times a year. The Inner Cabrillo Beach Survey has now become a valuable tool for both public education and long-term scientific research.

119. MEASUREMENTS OF GR AVITATIONAL ACCELERATION ACROSS THE SAN JOSE FAULT ON CAL POLY POMONA CAMPUS

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Traces of the San Jose Fault are known to run through the California State Polytechnic University, Pomona campus. Several geotechnical investigations have been conducted to attempt to locate and classify these traces, but results have been inconsistent. The Seismic Review Board has classified several buildings on campus as some of the most seismically hazardous buildings of the entire CSU system. The CSU board of trustees recently voted to raze the iconic Classroom, Laboratory, and Administration building due to poor construction and seismic concerns, giving rise to more questions about the fault's location.

Several gravity profiles were measured across campus, in order to detect lateral changes in gravitational acceleration. The goal of these surveys was to ascertain whether any gravity anomalies could be detected that would correspond to the proposed locations of the San Jose fault. The profiles were chosen to run perpendicular to traces of the fault as mapped by the GeoCon geotechnical investigation and were further refined based on practical considerations. The surveys were conducted using a LaCoste and Romberg gravimeter and a total station surveying instrument, ensuring accurate elevation measurements as required for high quality gravity corrections. After applying a physically realistic range of elevation correction values, it was determined that the gravitational accelerations indicate a lateral variation of subsurface density consistent with the possible presence of the San Jose fault. Profiles of elevation, free air, and Bouguer gravity anomalies are presented and the results are compared with those from previous geotechnical trenching and geological mapping studies

120. IMPACTS OF NON-NATIVE GRASSES IN A COASTAL SAGE SCRUB-CHAPARRAL TRANSITION ZONE

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Non-native grasses become abundant after fire and can alter environmental conditions and resource availability during early post-fire years. Longer-term persistence of non-native grasses can occur and limit

the establishment and growth of native species. An intense wildfire burned across the entire San Dimas Experimental Forest in the San Gabriel Mountains of Southern California in 2002, and the recovering community still contains large areas of non-native grasses. The objectives of this study were to describe the distribution and abundance of non-native grasses and possible impacts of non-native grasses on the native plant community eight years after the last fire. Questions were addressed by measuring microenvironmental factors and sampling vegetation during May and December 2010 on fifty 28-m^2 plots across a 110-ha study area. Correlation analysis, two-sample tests, and classification and ordination procedures were used to analyze the data. Jackknife estimates of species richness declined from 38 in May to 32 in December. Simpson diversity (1-D) declined from 0.560 in May to 0.479 in December. Significant differences were found in soil K, pH, and water potential between the May and December 2010 sampling periods. Native shrub cover was negatively correlated with non-native grass cover during both sampling periods. Non-native grass cover was positively correlated with distance from fuel breaks. Results suggest that an understanding of the local microclimate and the possible effects of non-native grasses on microenvironmental factors will aid restoration efforts to improve degraded native habitat and restore ecosystem functionality.

121. LIPOSOMAL H1N1 M2E VACCINATION STIMULATES PRODUCTION OF ANTIBODIES TO H5N9 IN CHICKENS AND MICE

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Avian influenza virus (AIV) is a major problem for the poultry industry due to difficulties in differentiating AIV outbreaks in vaccinated poultry when immunized with conventional hemagglutanin vaccines. Using a novel conserved antigen, M2e, formulated as a liposomal vaccine (L-M2e, H1N1), we tested this vaccine's ability to produce antibodies in chickens and mice against AIV (H5N9). B19 Chickens were vaccinated (n=6/group) sc d0, i.n. d28 and d42 with 5, 15, or 30μg of L-M2e (1-15 aa) or L-Control (no M2e). Blood was taken to determine ELISA antibody (Ab) concentrations against H5N9 M2e (1–30aa), and to measure viral inhibiting Ab (VIAb) titers against H5N9. Sera from BALB/c mice immunized with L-M2e (sc d0, i.n. d56) were tested for its reactivity against H5N9 in the VIAb assay. Sera from the L-M2e vaccinated chickens had the highest ELISA anti-M2e IgG concentration at 1 week post (1wkp) 2^{nd} boost when given 5μg L-M2e. Sera from the L-M2e chicken groups was tested in the VIAb assay, and the highest Ab titer was observed with the 5μg dosing; with titers of >1:40 after 1wkp boost and >1:80 after 1wkp 2^{nd} boost. Mouse L- M2e sera had VIAb titers against H5N9 at 1:10. Although the M2e sequence was derived from the H1N1 virus, the L-M2e vaccine given to either mice or chickens produced antibodies that could inhibit the replication of H5N9. These results demonstrate the conserved nature of the M2e peptide and evidence that this vaccine has potential to protect birds and mammals from different influenza strains.

122. SETTLING PREFERENCES OF THE NATIVE AND NON-NATIVE OYSTERS OF NEWPORT BAY

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Methods for restoring Olympia oysters, *Ostrea lurida*, in US west coast estuaries typically focus on augmenting mudflat habitat with readily available Japanese oyster shell in the hopes that locally produced Olympia oyster larvae will settle upon the introduced substrate. However, non-native Japanese oysters are also typically recruiting into the same estuaries raising the question whether augmenting habitat for Olympia oysters will also inadvertently benefit non-native Japanese oysters. If oysters show a species-specific preference to settle upon congener shells, then Olympia oyster shell would be a more efficacious choice of substrate in habitat restoration projects. Here we use both controlled laboratory experiments and field-deployed settlement arrays to explore whether Olympia and Japanese oysters settle at a higher rate on congener shells versus shells of other oyster species. Tees with native or non-native shell (n= 20 for each

species) will be deployed for two weeks on a mudflat in Newport Bay, California to determine settlement preferences in the field. After retrieval, we counted spat per shell under a dissecting microscope. In the lab, native and non-native larvae (ten larvae per replicate jar, n= 5) that are competent to settle will be exposed to five different treatments including 0.2 micron-filtered seawater seasoned with live Olympia oyster filtrate, live Japanese oyster filtrate, Olympia oyster shell filtrate, Japanese oyster shell filtrate or a control. We will calculate % settlement and analyze data using ANOVA. In the field, there was no significant difference in settlement of native oysters onto conspecific versus non-native shell (One-tailed t-Test, p = 0.3315). Expected results lab are that oysters will prefer to settle onto conspecific shell.

123. FISH PRODUCTION OF THE SOUTHERN CALIFORNIA OIL PLATFORMS

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Beginning with empirically collected submersible data, the biological implications of oil platform decommissioning were modeled. First, stock estimates were made for eight well studied platforms that each represented the major offshore habitats where the 27 current platforms were found. Stocks were estimated for both the entire platform and those below the proposed topping depth (26 m). Somatic production was estimated using the von Bertalanfy growth equation for all fishes. Using an annual mortality and recruitment estimates, production was calculated for a five year period. Somatic production and recruitment varied among platforms due to location, size and age of the fish assemblages. Recruitment was not significantly affected by topping; a finding consistent with recent studies demonstrating that the bulk of rockfish recruitment was below the topping depth. Production estimates were high for both existing and topped structures, on average 1–2 orders of magnitude greater than rocky-reefs in the Southern California Bight.

124. ERRORS ASSOCIATED WITH CAVITATION RESISTANCE MEASUREMENTS OF PLANT STEMS WITH SPECIAL REFERENCE TO LONG VESSELS

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Xylem cavitation resistance in response to water stress is a key trait that defines the range of water potentials over which a plant can extract water from soil and maintain water flow to photosynthesizing leaves. Studies of cavitation resistance often use centrifugal force to generate negative xylem pressures. Centrifuge techniques are common in such studies because they are rapid, accurate, and reliable. Two recent studies have suggested that species with long vessels are prone to artifacts when analyzed using centrifuge techniques. We compared centrifuge generated data to data generated using a standard bench top dry down method for both long and short vesselled species. We find good agreement between vulnerability to cavitation measurements between these methods for both long and short vesselled species. Our data suggest that cavitation resistance can be accurately characterized for species with long or short vessels using centrifugal force. Three sources of error are presented that help explain why recent studies have found a discrepancy between centrifuge based measurements and dry down or native embolism measurements.

125. CONNECTING THE PIECES: CONSERVING AND RESTORING BIODIVERSITY IN SOUTHERN CALIFORNIA

Ronald D. Quinn. California State Polytechnic University, Department of Biological Sciences, Pomona, CA, 91768.

Connecting the fragments of natural areas remaining in southwestern California is the most important single measure to save the exceptional biodiversity of this region. Doing so would provide many recreational as well as conservation benefits. The remaining large pieces of nature in this region are almost entirely mountains and hillsides. Most of these are public land. The natural ecological communities of the valleys and wetlands have long since been almost entirely given over to intensive human uses. However,

numerous regional watercourses cross the valleys and connect all the mountains, hills and foothills with the coast. These too have been drastically altered, but they do present an important opportunity for ecological and hydrologic restoration because they must remain in public ownership. A natural network of restored rivers and greenways could place outdoor recreation close to most residents of this vast megalopolis – avenues for people and for nature. Recent promising developments toward connecting and preserving the pieces include the San Gabriel Watershed and Mountains Special Resource Study (National Park Service), San Gabriel Mountains Regional Conservancy (state/local partnerships), the Rim of the Valley Trail Corridor (National Park Service), and the recently introduced federal legislation, Angeles and San Bernardino National Forests Protection Act (H.R. 113). The success of these and other efforts requires cooperation and coordination between numerous public and private agencies and interest groups. Citizens, non-government organizations, and public agencies will be most effective in connecting pieces of nature together by planning regionally while acting locally, one link at a time.

126. SECONDARY POLLEN TRANSFER BY HONEY BEE (APIS MELLIFERA) & NATIVE BEE POLLINATORS IN WATERMELON (CITRULLUS LANATUS)

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Watermelon, *Citrullus lanatus,* can be pollinated by native bees and honey bees. Previous studies measured the pollen deposition abilities of bee pollinators by quantifying primary pollen transfer to female flowers. Our goal is to assess whether bees can deposit watermelon pollen on stigmas through the mechanism of secondary pollen transfer. Secondary pollen transfer occurs when pollen grains are transferred to a flower by an initial pollinator, and are subsequently transferred to a stigma by a second pollinator. Our objective is to determine how much secondary pollen transfer occurs from petal surfaces to the stigma of the same female flower. We examined pollen remobilization rates from petals and rates of intra-floral pollen transfer from petals to stigmas. Petals of experimental flowers were marked with stained pollen grains and placed in floral arrays. We allowed pollinator visits for a 30 minute time interval between 8:00 am and 12:00 pm, then pollen grains were counted. Pollen was also counted from the petals of open control female flowers to establish a pollen accumulation curve. At Spadra Ranch (Pomona), an average of 32% of stained pollen grains were remobilized by native bees and honey bees and an average of 34% of pollen grains were secondarily transferred. At Tanaka Farms (Irvine), an average of 46% of stained pollen grains were remobilized and an average of 42% of pollen grains were secondarily transferred. Our results provide the first empirical evidence that secondary pollen transfer can play a significant role in the pollen transfer dynamics of field populations.

127. PHYSIOLOGICAL DIFFERENCES OF TWO DESERT SHRUBS ACROSS DIFFERENTLY-AGED SUBSTRATES IN THE MOJAVE DESERT

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Desert ecosystems are not often considered diverse in terms of productivity, however, detailed investigations of the underlying physiology of desert plants suggest that this perception is overly simplified. In this study, we explored variation of productivity on a single bajada using two dominant Mojave Desert shrubs (*Larrea tridentata* and *Ambrosia dumosa*) across four differently-aged substrates. These substrates ranged in age from < 200 years up to 300,000 years. We examined leaf-level physiological diversity over smaller spatial scales than previously studied, and predicted that plants on intermediate aged substrates (3,000 to 16,000 years) would show significantly greater physiological performance due to these soils having the most favorable resource conditions. Although there were clear differences in plant performance between neighboring substrates that spanned the 300,000-year chronosequence, we found that plants on intermediate-aged substrates actually had the lowest individual performance. This result may be explained by the influence of substrate on other factors, such as plant abundance and competition, but nonetheless demonstrates that variable productivity is present on small spatial scales in this desert and is coupled with heterogeneity owing to substrate age.

128. THE RELATIONSHIP OF LEAF VENATION ARCHITECTURE TO LIFE HISTORY IN TROPICAL DRY FOREST TREES

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The plant leaf venation architecture is fundamental to physiological function, and thus venation traits have recently gained a great deal of attention. Recent work has shown leaf venation density (=length/area) to be related to sun adaptation and maximum photosynthetic rates, and that the density of major veins may be related to tolerance of damage and drought. However, role of vein traits in life history, demographics and niche partitioning, and their coordination with other functional traits have yet to be well-described. We measured leaf venation traits in detail for 31 tree species from Bolivian dry forest to analyze their correlations with other morphological, anatomical and physiological traits, and with seedling demographic rates. We explore hypotheses for the mechanisms and implications of these relationships.

129. MITOCHONDRIAL PHYLOGEOGRAPHY OF THE GECKO GENUS *CNEMASPIS*

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Cnemaspis is a southeast Asian endemic genus of geckoes. Geckos are distinctive reptiles from an ancient family of lizards (Gekkonidae) of several thousand species worldwide. Their distinctive characteristics include big circular pupils, long toes, unique chirping vocalizations, and feet with close-set ridges or setae, which permits them to adhere to almost any surface. In this study, the mitochondrial gene encoding NADH dehydrogenase subunit 2 (*ND2*) was sequenced from populations surrounding the South China Sea. Phylogenetic analyses of these sequences recovered five major lineages, including one new species, reflecting the radiation and dispersal of this ancient genus across this region.

130. THE MAKING OF THE AGE OF MAMMALS: A BEHIND THE SCENES LOOK AT EXHIBIT PREPARATION & DISPLAY

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The new *Age of Mammals* exhibit at the Natural History Museum of Los Angeles County showcases Cenozoic fossils in a new light. Over 120 vertebrate fossil specimens tell the story of how continents move, climates change, and mammals evolve. The expertise of museum curators, fossil preparators, and design professionals bring to life mounted skeletons, isolated elements, fossil replicas, and touch specimens in a dynamic and interactive setting. Laboratory work spanned over three years to prepare, repair, mount, and cast fossil specimens. The preparation and mounting process of our juvenile sperm whale, *Aulophyseter morricei*, and the new desmostylian, Paleoparadoxiidae, highlight some of the challenges and achievements of the exhibit. In addition to selecting specimens and providing the intellectual framework, museum curators and consultants were responsible for label copy, design, illustration, multimedia, fabrication, mounting, installation, and lighting. The exhibit, *Age of Mammals*, received outstanding reviews from a wide variety of media outlets such as Science magazine and the Los Angeles Times.

131. GENETIC TESTS OF BIOPHYSICAL MODELS OF THE CARIBBEAN

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Biophysical models use ocean currents and biological factors to predict dispersal patterns of marine organisms. Such models for the Caribbean predict four major regions between which individuals are unlikely to pass: the Bahamas along with Turks and Caicos; the East coast of Central America, isolated by

the Panama-Columbia Gyre; and an Eastern and a Western region, separated by the Mona Passage. To compare these predictions with empirical data, I am evaluating genetic markers from four species of sacoglossan sea slugs. In addition, I am comparing my data with dispersal predictions that are based on pelagic larval duration (PLD). Since benthic invertebrates generally disperse only during a free-swimming larval stage, species with PLDs of a month or longer are expected to have wider ranges than those with PLDs of hours to days. Some sacoglossan species have no free-swimming larvae, and are expected to have limited dispersal. However, data from our lab show a lack of correlation between PLD and dispersal. Our results emphasize the need to incorporate species-specific larval swimming behavior into existing hypotheses. Accurate predictions of marine dispersal patterns are needed to effectively manage fisheries and marine protected areas.

132. SECRETION AND EVOLUTIONARY CHARACTERIZATION OF THE PROTEINS OF THE SERINE PROTEASE AUTOTRANSPORTERS OF *ENTEROBACTERIACEAE* (SPATE) FAMILY

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The autotransporter pathway is a secretion system utilized by Gram-negative bacteria for transporting large virulence proteins to the extracellular environment. These proteins contain three distinct domains: an N-terminal signal sequence for inner membrane translocation, a functional passenger domain and a C-terminal translocator domain for outer membrane translocation. Serine protease autotransporters of *Enterobacteriaceae* (SPATE) are a subfamily of autotransporters, involved in bacterial pathogenesis. In this study, a SPATE protein called temperature-sensitive hemagglutinin (Tsh) is used as a model to study the secretion mechanism of autotransporters. Bioinformatics tools such as BLAST, SignalP 3.0 and ClustalX were used for a database search for all complete protein sequences found in Gram-negative bacteria. Three conserved residues of the signal peptide were used to construct single, double and triple mutants by site-directed mutagenesis. All constructs were expressed in *E. coli* K12 strain XL1-Blue. Protein expression was induced using IPTG. Cell fractionation was performed to get samples of culture medium, outer membrane (OM) and periplasm. The samples were resolved using SDS-PAGE and visualized by silver staining. Western blotting was carried out using anti-Tsh antibody. Bioinformatics analysis has identified 16 new SPATE proteins. Our further studies using the Tsh mutants revealed ~40% decrease in secretion in the culture media and periplasm, while in OM fractions, the overall amount of protein remains the same. This study shows that the conserved motif found in the signal peptide is important for protein secretion. Additional mutations will provide more information on the role of this conserved motif.

133. FIRST RECORDS OF FOSSIL FISH REMAINS FROM NORTHERN EXPOSURES OF THE MARINE IMPERIAL FORMATION, RIVERSIDE COUNTY, CALIFORNIA

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Recent work in outcrops of the marine Imperial Formation (IF) at Super Creek (SC), near Whitewater and Willis Palms near Thousand Palms, Riverside County has yielded the remains (otoliths, teeth) of first fossil marine fish from northern exposures of this rock unit. From SC, University of California, Riverside locality (UCR) 7477, the following fishes were recovered: Sciaenidae (croakers-genus *Umbrina*), Ophidiidae (cusk-eels-genus *Lepophidium*-two species), Congridae (conger eels), Bregmaceridae (codlets-genus *Bregmaceros*), Gerreidae (mojarras-genus *Gerres*), Haemulidae (grunts-genus *Orthopristis*), Apogonidae (cardinal fishes-genus *Apogon*), Myctophidae (lanternfishes-genus Diaphus), Gobiidae (gobies), Lutjanidae (snappers-genus *Lutjanus*), Bothidae (flat fishes-genus *Citharichthys*) and Atherinidae (silversides). Except for *Diaphus* and *Bregmaceros*, the other fish species recovered from this site indicate a shallow offshore paleoenvironment. Today, *Diaphus* makes diurnal migrations from depths of about 650 m to upper 10 m of water at night to feed while *Bregmoceros* is found in deeper waters. Today, the cardinal fish, mojarra, grunt and snapper are considered warm water fishes. Based on age-diagnostic benthic foraminifers, planktonic foraminifers and calcareous nannoplankton coupled with K/Ar dates on the

underlying Coachella Formation (10.1 ± 1.2 Ma) and the overlying Painted Hill Formation (6.04 ± 0.18 and 5.94 ± 0.18 Ma), and paleoecologic considerations (sea-level fluctuations and paleotemperature) restrict the age of the Whitewater IF to 6.3 to 6.5 Ma (late Miocene) (McDougall, et al 1999).

From Pliocene age Willis Palm IF, field locality CP-01172011 has yielded the following marine fishes: Sciaenidae (croakers-genus *Cynoscion*), Gobiidae (gobies), Kyphosidae (chubs), Triakididae (leopard sharks-genus *Mustelus*), Dasyatididae (stingrays-genus *Dasyatis*), Myliobatididae (bat rays-genus *Myliobatis*) and Rhinobatidae (guitarfishes-genus *Rhinobatos* or *Zapteryx*).

134. PHOTOSYNTHETIC CHARACTERIZATION OF INVASIVE PLANT SPECIES IN LOS ANGELES COUNTY, CA

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An invasive species by definition is a non-native organism that both spreads in space and has negative effects on native habitats. Invasive species dominate the habitats they invade because of their ability to thrive without experiencing native herbivory. Invasive plant species are known to threaten the integrity of agricultural and natural systems throughout the world. We are using the specimen information for invasive species registered in the Consortium for California Herbaria of the University of California Berkley to track historical patterns of arrival in LA county (n=15,000). Additionally, we are evaluating the community dynamics of 1,008 invasive species in the Los Angeles County area. Findings show both diversity and richness increased over a period of 180 years. We are currently determining photosynthetic pathway for each invasive species in our database. We hypothesize that the pattern of occurrence of a given photosynthetic pathway may correlate with historical changes in CO2, favoring C3 invasives.

135. MODULATION OF ATTENTION BY STIMULUS CONCORDANCE IN HERMIT CRABS (*COENOBITA CLYPEATUS*)

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Previous research has shown that hermit crabs are negatively impacted by anthropogenic noises in their environment. Specifically, research has found that crabs react more slowly to a looming visual predator in the presence of an auditory stimulus than in a silent condition (Chan et al., 2010). We measured the crabs' latencies to hide to a visual predator across three unique conditions: a white noise positioned next to the visual predator (i.e., Concordant Condition), a white noise away from the visual predator (i.e., Discordant Condition), and a Silent Condition. We hypothesized that if the results previously observed were due to underlying attentional processes, then the crabs would be slower to hide in the Discordant Condition than the Concordant Condition. This study was important because a behavior not previously reported in hermit crabs was observed: freezing. We found that crabs were more likely to freeze prior to hiding in the Silent and Concordant Conditions than in the Discordant Conditions. In addition, we discovered differences in the crabs' latencies to react to the visual predator in a fearful manner. We discuss these differences in terms of attentional processes.

136. SUBCELLULAR LOCALIZATION OF THE GFP-CDC7 SIGNAL UNDER THE NATIVE PROMOTER IN DIFFERENT PHASES OF THE CELL CYCLE IN THE PRESENCE AND ABSENCE OF DBF4 IN *SACCHAROMYCES CEREVISIAE*

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Cdc7(Cell Division cycle) protein is a serine/threonine kinase protein conserved from yeast to humans. This protein gets activated by forming a complex with Dbf4 in *Saccharomyces cerevisiae* or ASK in mammals. The two protein kinases, Cdc7-Dbf4 kinase (DDK) and the cyclin-dependent kinase (CDK), trigger a chain reaction that causes the phosphorylation of the MCM complex as well as in the initiation of

DNA synthesis. Therefore this complex is known to regulate the cell cycle. Previously, a fusion protein containing the Cdc7p with the green fluorescent protein (GFP) was produced in the laboratory. By examining the GFP-Cdc7p in the yeast with or without Dbf4p expression, we should be able to determine the subcellular location of the Cdc7p during the cell cycle and the effect of Dbf4p on Cdc7p's subcellular location.

To determine the different subcellular locations of Cdc7p, a specific strain of *Saccharomyces cerevisiae* was used (BJ5459) that had been transformed with two plasmids, pNCCDC7GPNAT, having the GFP-Cdc7 fusion gene under control of the native Cdc7 promoter, and pRSDMC4, having the Dbf4 gene under the Gal promoter. My results have shown that Cdc7p under the native promoter was expressed throughout the cell cycle but there were differences in the expression location relative to the nucleus. *Saccharomyces cerevisiae* was grown under two conditions; Dbf4 was expressed under the galactose media and repressed under the glucose media. Fluorescence microscopy was used to monitor the subcellular localization of GFP-Cdc7 and its intensity. Results suggested that in addition to the changes in subcellular location, when Dbf4 was expressed, the fluorescence intensity of GFP-Cdc7 also increased.

To verify the expression and amount of GFP-Cdc7 protein within the protein lysate, western blot was performed with asynchronous cells. The preliminary western blot results showed an 85KDa GFP-Cdc7 protein. BJ5459 yeast expresses endogenous levels of Dbf4p, we are currently transforming the pNCCDC7GPNAT plasmid into a temperature sensitive dbf4-3 yeast cells to determine the subcellular localization of GFP-Cdc7p without either exogenous or endogenous Dbf4p present.

137. LUPINE RECRUITMENT IN A DUNE RESTORATION AT THE BALLONA WETLANDS

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A coastal dune remnant occurs along the western boundary of the Ballona Wetlands ecosystem where adjacent buildings have modified the environment. As a result, sand movement has decreased due to reduced wind action. In 1994 with the creation of the Ballona Dunes Restoration Program (Friends of Ballona Wetlands), non-native vegetation consisting largely of ice plant, *Carpobrotus edulis*, was removed from this site and replaced by native species. Monitoring of vegetation showed that in 2001, the dominant species were *Lupinus chamissonis*, *Phacelia ramosissima*, and *Lotus scoparius*. Several other species were also found, including the uncommon *Erysimum insulare* ssp. *suffrutescens*, which together with the sand verbena, *Abronia umbellata*, occurred predominantly in the more open sandy areas. A comparison of species cover over the past ten years has shown that *L. chamissonis* and *P. ramosissima* are increasing in dominance with a potential for the reduction of species diversity in the dunes. The role of seedling recruitment in this process is being investigated. The number of seedlings of each species is being recorded along transects throughout the dunes, together with canopy and substrate characteristics. The majority of seedlings are *L. chamissonis* and *P. ramosissima* and frequently germinate in detritus. Areas without extensive cover of *L. chamissonis* have higher seedling diversity and few germinating lupines. These results suggest that *L. chammissonis* may indeed come to dominate the vegetation of the area unless management strategies to maintain diversity in the dunes are implemented.

138. MEASURING POLYMORPHISM OF RESISTANCE GENES IN A POPULATION OF ENCELIA FRUTESCENS RESIDING IN IBEX CALIFORNIA

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Plants have evolved a resistance against harmful pathogens through a defense mechanism known as the gene-for-gene resistance. This mechanism is initiated when interactions between the plant's resistance (*R*) gene and the corresponding pathogen's avirulence (*Avr*) gene activates a cell death response in the plant that is restricted to cells surrounding the pathogen and thus, starves the pathogen to death. Many resistance genes have evolved as a result of many pathogen invasions. This experiment will be undertaken in order to measure the polymorphisms of resistance genes in a population of the plant species *Encelia frustescens* in Ibex, California where the pathogen pressures that the plants face are unknown, due to few past studies, and thus can vary widely. Twenty individuals from Ibex have been selected for isolation of

their genomic DNA. Polymerase Chain Reaction using degenerate primers will be used to find specific (R) gene analogues in the *Encelia* population that will serve as specific primers to isolate (R) genes from sequential individuals. Sequencing of these genes are necessary to determine the level of resistance gene polymorphism in the population. At an ecological level, it can be assumed that the more polymorphic a plant population is at its R loci the more advantageous it will be for its survival and reproduction.

139. XYLEM VULNERABILITY AND HYDRAULIC ARCHITECTURE AS DETERMINANTS OF DROUGHT RESISTANCE IN DESERT CHAPARRAL VEGETATION

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The desert-chaparral transition represents an intersection of two major vegetation types in California and contains a mix of chaparral and desert shrubs, as well as endemic species that only occur along this margin. This vegetation boundary has large potential for drought-induced vegetation change because nearly all species are at the edge of their range. We studied 17 species to determine how drought avoidance and resistance strategies such as drought deciduousness, rooting depth, and vulnerability to xylem cavitation promote species co-existence in an ecosystem of considerable floristic complexity. We identified several major trade-offs in hydraulic strategies. Leaf area:sapwood area increased with xylem vulnerability illustrating a trade-off in hydraulic architecture. Species with high rates of hydraulic conductivity had greater vulnerability to xylem cavitation illustrating a trade-off between safety and efficiency of water transport. Rooting depth and minimum seasonal water potential also played key roles in determining plant strategies and likely contribute to species coexistence in this functionally diverse arid ecosystem.

140. EVIDENCE OF EARLY CAMBRIAN DEPOSIT FEEDING FROM SOUTHEASTERN CALIFORNIA: IMPLICATIONS FOR ENVIRONMENTAL AND ECOLOGICAL EVOLUTION THROUGH THE PRECAMBRIAN-CAMBRIAN TRANSITION

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Zoophycos-group burrows are prevalent elements of the trace fossil record throughout the majority of the Phanerozoic and are among the most celebrated trace fossils in all of ichnology. Here we report the oldest definitive specimens of *Zoophycos* from Lower Cambrian strata in the Lower Member of the Wood Canyon Formation in southeastern California. Eight specimens were found approximately 40 m above the Precambrian-Cambrian boundary within what has been previously determined to be the *Rusophycus avalonensis* trace fossil zone. This makes these specimens significantly older than any other purported occurrences of *Zoophycos*. In that these specimens are simple, basically two-dimensional forms occurring with well-defined mud-sand spreite in the absence of a vertical axis and/or any evidence of vertical movement of sediment, the most parsimonious explanation for these specimens is that of a horizontal deposit feeder as has been suggested for other examples of *Zoophycos* (e.g. Seilacher, 1967, 2007). The discovery of these specimens not only expands the range of *Zoophycos* nearly to the base of the Cambrian but also reveals the presence of complex burrowing activity and deposit feeding considerably earlier than has been suggested for the advent of this feeding style. Additionally, this behavior may have had a significant impact on the nature of the substrate during the Precambrian-Cambrian transition. However, the rarity and shallow tier position of these trace fossils suggests that this behavior would have had a limited role at best in elucidating the sweeping environmental and ecological changes occurring at this time.

141. CONTAMINATION IN SOUTHERN CALIFORNIA RECREATIONALLY-CAUGHT MARINE FISHES

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Southern California has an active marine fishing community, where recreational and tourism generate more than 125,000 ocean related jobs and approximately $5 billion in economic revenues. Southern California is also home to some widely contaminated ocean ecosystems including one of the only designated offshore marine superfund sites in the country. This level of contamination can lead to important human health risks for seafood consumers. Unfortunately, seafood monitoring is often localized and no large-scale monitoring or consistency in health risk interpretation currently exists for this dynamic region. The goal of this study was to create the first regionwide monitoring of seafood safety conducted in Southern California for over a decade. More than 1,700 fish were collected, comprising the top five-most landed recreational sportfish species. Samples of edible tissues were analyzed for mercury and chlorinated hydrocarbons. A clear gradient of tissue concentrations for chlorinated hydrocarbons was evident near the largest urban centers where multiple species exceeded health risk thresholds for PCBs. In contrast, no spatial gradient was observed for mercury, but this contaminant exceeded health risk thresholds most frequently, and by the greatest magnitude, across Southern California.

142. STATUS OF THE WHEELER NORTH ARTIFICIAL KELP REEF TWO YEARS POST-CONSTRUCTION

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The Wheeler North Reef is a 176-acre low relief reef composed of quarry rock boulders and cobbles. Constructed in the summer of 2008, its goal is to replace giant kelp and associated resources impacted by the operation of the San Onofre Nuclear Generating Stations 2 and 3. We discuss the design of the reef, the monitoring protocols used to evaluate it's success, and provide an update of the status of the reef in the first two years after its construction was completed.

143. DECLINE OF LEAF HYDRAULIC CONDUCTANCE WITH DEHYDRATION: RELATIONSHIP TO LEAF SIZE AND VENATION ARCHITECTURE

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Across plant species, leaves show enormous variation in size and in venation architecture, of which one major function is to replace water lost to transpiration. The leaf hydraulic conductance (K_{leaf}) represents the capacity of the transport system to deliver water, allowing stomata to remain open for photosynthesis. Previous studies showed that K_{leaf} relates to the vein density (= vein length per area). Additionally, venation architecture determines the sensitivity of K_{leaf} to damage; severing the midrib caused K_{leaf} and gas exchange to decline, with lesser impacts in leaves with higher major vein density, which provides more numerous water flow pathways around the damaged vein. Because xylem embolism during dehydration also reduces K_{leaf}, we hypothesized that higher major vein density would confer lower hydraulic vulnerability. Smaller leaves, which have intrinsically higher major vein density, would also have lower hydraulic vulnerability. Tests using simulations with a spatially explicit model confirmed that smaller leaves with higher major vein density were more tolerant of major vein embolism. Additionally, for ten species ranging strongly in drought tolerance, hydraulic vulnerability determined as the leaf water potential at 50% and 80% loss of K_{leaf} correlated negatively with major vein density and positively with leaf size ($|r| = 0.80$–0.86; $P < 0.01$). These relationships were independent of other aspects of physiological and morphological drought tolerance. These findings point to a new functional role of venation architecture and small leaf size in drought tolerance, and potentially contributing to well-known biogeographic trends in leaf size.

144. FUNCTIONAL CONSEQUENSES OF VARIATION IN COMMUNITY STRUCTURE IN RESPONSE TO CLIMATE CHANGE: INSIGHTS FROM A MODEL ECOSYSTEM

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Rapid climate change is significantly altering biodiversity from local to global scales. If we are to predict the impacts of such change successfully, we must understand the links between environmental conditions and associated community structure. We are using species identity and abundance data collected along a 175-m horizontal transect in the mid-intertidal zone at Hopkins Marine Station in Pacific Grove, CA, to explore relationships between species diversity and locally-measured environmental variables that include maximum wave forces, temperature variability, and microalgal productivity. Although standard measures of diversity (e.g., richness, evenness, and Simpson's 1/D) exhibit no pattern with respect to presumed abiotic drivers, more sensitive multivariate analyses (e.g., Canonical Analysis of Principal Coordinates, CAP) reveal significant relationships between the environment and community structure. This pattern is largely driven by the predictable responses of certain species: for example, abundances of the mussel *Mytilus californianus* and limpet *Lottia gigantea* are negatively correlated with low wave forces and corresponding high temperatures, whereas those of algae such as *Endocladia muricata* and *Mastocarpus papillatus* are positively correlated. The replacement of a given dominant species by taxa exhibiting very different functional traits is likely to have a dramatic effect on a variety of ecosystem functions that include primary productivity, energy transfer among trophic levels, nutrient cycling, and habitat provisioning. By understanding how community structure varies across a range of environmental conditions today, we gain insight into the potential response of community structure to changing conditions in the future.

145. PREDICTING THE WATER CONTENT OF *LARREA TRIDENTATA* USING SPECTRAL INDICES

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Analyzing leaf optical properties has become a useful method for measuring plant physiological status. The measurements become fast and affordable when coupled with remote sensing, but must first be tested for accuracy on the species of interest. In this study, we examined the correlation between spectral water indices and relative water content of individual leaves for the desert shrub, *Larrea tridentata*. Leaf-level reflectance measurements were taken periodically as detached *Larrea* branches desiccated. Four spectral indices were determined from the reflectance data: the water index (WI), the normalized difference vegetation index (NDVI), the normalized water index (nWI) and the structure independent pigment index (SIPI). Index values were compared to measurements of leaf relative water content to determine how well these indices predict plant water status. All indices showed a relatively linear relationship across water contents raging from 7 to 70%. WI had the most predictive capability, however the correlation is relatively weak (R^2=0.529). This study shows that there is a correlation between leaf reflectance and the water status of *Larrea tridentata*, but the indices may only be valuable when looking at large differences in RWC.

146. EXPRESSION OF MULTIPOTENCY MARKERS IN ADULT ADIPOCYTE-DERIVED STEM CELLS AS A FUNCTION OF TIME

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White mature adipocytes have been shown to lose their fat in culture and de-differentiate into so-called de-differentiated (DFAT) cells. The DFAT cells are able to differentiate into multiple cell lineages including fat, bone, cartilage, skeletal muscle and cardiomyocytes. Immediately after the loss of lipids, DFAT cells express several stem cell markers as a sign of multipotency and ability to differentiate into different lineages. However, it is not known for how many cell passages the cells continue to express stem cell markers, information that is essential in defining how long the cells can be used a source of multipotent cells. To test the longevity of DFAT cell expression of stem markers, mouse DFAT cells were cultured for up to 10 passages, starting immediately after the generation of DFAT cells from isolated adipocytes (passage 0). Cellular RNA was extracted after each passage, and cells were fixed and prepared for immunostaining or fluorescence-activated cell sorting (FACS). Expression of stem cell markers was

determined by real-time PCR, immunofluorescence and FACS. Real-time PCR showed that expression of Oct3/4, Nanog and SOX2, pluripotency markers, gradually decreased to near undetectable levels over 10 passages. After ~ 2 passages, <25% of the original level of expression was observed. Immunofluorescence confirmed expression of Oct3/4 and Nanog in early passages, and also showed cells positive for SSEA-3, another pluripotency marker, and c-kit, a mesenchymal stem cell marker. Many of the cells grew in cell clusters, which is commonly seen in embryonic stem cells. FACS revealed that SSEA-3 expression gradually decreased to undetectable levels after ~5 passages, whereas Sca1, a general stem cell marker, only decreased to ~65% of the original level. Thus, it can be concluded that mouse DFAT cells maintain expression of stem cell markers at a level >25% of baseline (passage 0) for at least 2 additional passages. Optimally, DFAT cells should be used for regenerative purposes no later than two passages after the isolation of adipocytes used for DFAT cell generation.

147. PALEOINDIAN MOBILITY AND SUBSISTENCE AS EVIDENCED BY THE AMERICAN SOUTHWEST

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The decline in mobility by the end of the Paleoindian period (ca. 11,000 to 10,000 years ago) was caused by a gradual change in subsistence strategies that eventually led to increased sedentism in the Archaic period. Based on evidence from the American Southwest, Paleoindian mobility and subsistence patterns are discussed in light of the shift from a broad continental specialized hunting culture to a more regional and generalized hunting and gathering pattern that occurred in North America at that time. Through the use of theoretical, ethnographic, and archaeological models, the mobility and subsistence patterns of Clovis and Folsom Paleoindians are examined and a richer understanding of their lifeway is made possible through the present study.

148. EFFECT OF HIV INFECTION ON CYTOKINE LEVELS IN THE HUMAN IMMUNE RESPONSE

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Human Immunodeficiency Virus (HIV) is a lentivirus that can lead to AIDS and eventually death if left untreated. The increase in its prevalence means continuous challenges for prevention and treatments. Upon infection, HIV compromises the immune system by targeting and destroying helper T-cells. Cytokines are a large family of signaling proteins that play a significant role in immune cell activation, differentiation, and viral defense. The major objective of this study is to examine the levels of five different cytokines upon acute HIV infection in humans. These included IFN-γ, TNF-α, IL-2, IL-12, and IL-17. HIV infected and healthy human plasma samples were tested for the levels of cytokines via ELISA assays. The experimental data showed an increase in cytokines IL-17 and TNF-α and decrease in the levels of IL-2, IL-12, and IFN-γ. The current data indicates that pro-inflammatory cytokines are increased and immune response mediators are decreased. This suggests the observed lower levels of immune response mediators may be directly or indirectly responsible for the development of opportunistic infections. Future experiments will examine the exact mechanism of action leading to the current findings, particularly the role of viral antigens on cytokine levels.

149. THEORETICAL AND COMPUTATIONAL ISSUES IN FLUORESCENCE MICROSCOPY BEYOND THE DIFFRACTION LIMIT

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Superresolution microscopy techniques enable imaging of live cells with subwavelength resolution. In these techniques, fluorophores are switched on and off, with a sparse subset emitting light at any given time. Consequently, the fluorophores form non-overlapping blurs in the image plane, enabling localization of molecules with subwavelength resolution limited only by noise in photon detection. We used theoretical, statistical, and computational techniques to determine fundamental limits of performance. Using a kinetic model of the fluorophores, we proved the existence of an optimal image acquisition scheme, that maximizes the number of single-molecule images (i.e. no over-lapping blurs). In this scheme, the error rate (ratio of the number of multi-molecule overlap images to the number of images of single molecules) is constant. Interestingly, for fast acquisitions, the scheme is very robust: Deviations from the optimal scheme decrease the number of good images, but decrease the number of bad images (overlaps) to partially compensate.

We also developed a formalism for benchmarking algorithms that correct errors by removing overlap images. Only a handful of algorithm performance parameters are shown to matter, suggesting the possibility of fast error correction algorithms based on simple principles. Finally, to optimize the localization procedure, we developed a rapid approximation to the Gaussian Mask technique for least squares fits. Our algorithm significantly reduces the number of function evaluations needed. The results are similar to applying the Gaussian Mask algorithm to images that underwent noise filtering. This suggests the possibility of fast localization analysis on images represented in special bases.

150. CONSERVED RESIDUES WITHIN THE A-LINKER AND B-BARREL DOMAINS OF A SERINE PROTEASE AUTOTRANSPORTER ARE CRITICAL FOR EFFICIENT PROTEIN SECRETION

E.J. Smith, A. Rodou, and C. Stathopoulos. Department of Biological Sciences, California State Polytechnic University, Pomona, California 91768.

Bacterial protein secretion is a key factor in bacterial disease. The autotransporter (AT) pathway is used by gram negative bacteria to secrete large proteins in a two-step manner. The second step is poorly understood but involves a C-terminal domain of the AT that folds into a β-barrel, inserts into the outer membrane of the bacteria and facilitates the transport of the rest of the protein to the extracellular space. An α-linker tethers the rest of the protein to the β-barrel. To understand the mechanism by which SPATE (a family of ATs) are secreted we constructed six double mutants (DMs) of our model SPATE protein, Temperature Sensitive Hemagglutinin. Previous studies found one conserved region within the α-linker and four within the β-barrel, and identified key residues, which were used to construct our DMs. Three DMs were comprised of all α-linker residues, while the remaining three were combinations of α-linker and β-barrel residues. All DMs showed secretion defects. The severity of secretion defects was examined by fractionation. All three of the α-linker DMs showed phenotypes that were combinations of their comprising single mutants. Two of the β-barrel mutants showed combined phenotypes of their single mutants as well but the third showed only the α-linker mutant's phenotype. This indicates that the α-linker and β-barrel work together in at least one step during secretion, but at least one β-barrel residue is involved in a separate stage of secretion. Using our results and recent publications, we present an updated model of SPATE secretion.

151. CHANGES IN WILD CANID VISITATION PATTERNS WITHIN THE PALOS VERDES NATURE PRESERVE

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The Palos Verdes Nature Preserve, located on the southern slope of the Palos Verdes Peninsula, contains quality coastal sage scrub habitat that supports a diverse number of native fauna, including coyote (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), and red fox (*Vulpes vulpes*). These canids have been tracked regularly since 2006 to satisfy the requirements of the draft Natural Communities Conservation Plan for the Preserve. During the first four years of monitoring, general trends of the canid visitation were determined along with impacts from a 2009 wildfire that burned 187 acres used regularly by the coyote and fox. However, the 2010–11 survey season revealed a significant change in the animals' distribution, illustrating the complex nature of canid behavior. This poster explores a number of factors

that may help explain the distribution of coyote, gray fox, and red fox within the Palos Verdes Nature Preserve.

152. MEDICAL APPLICATIONS OF COMMENSAL BACTERIA

Justin Song. Torrey Pines H.S..

Hypothesis: If the temperature of Propionibacterium Acnes' culturing environment is changed from the optimal 37°C to another temperature, fluorescence intensity levels will decrease. This experiment was designed to test fluorescence intensity fluctuation as a result of temperature change. Possible applications resulting from data could be used to identify temperature changes in humans, "fingerprint" people, and scan for other porphyrin-producing bacteria. Procedure: After culturing P. Acnes, two methods were used to determine if changes in fluorescence intensities actually occurred. One method utilized bacteria in suspension. Once the solutions were standardized by OD (using a spectrophotometer), they were placed in a spectrofluorometer to measure the intensity of emission spectra. The second method used fluorescent photography of the Petri dishes in which the bacterial cultures (treated with ALA to enhance fluorescence) grew. Pictures were taken using two different filters blocking and passing UV light respectively, and data (in the form of photographs) and a computer program was perform image analysis on the photos. Findings using spectrofluorescopy demonstrated that bacteria may actually produce more porphyrins or more fluorescence-intensive porphyrins at higher temperature per unit of bacteria. However, using fluorescence photography, the fluorescence intensity of 37° was found to be higher, possibly as a result of better growing conditions and a larger bacteria population. The latter method reflects *in vivo* conditions where bacterial growth/population may matter in overall fluorescence and impact applications. Both factors impact fluorescence intensity: the fact that porphyrin production (and fluorescence intensity) per colony increases as temperature increases and the fact that bacterial population density will increase total fluorescence per culture. Therefore, both methods must be used to first determine the impact that each has on the measurement process; then applications can be developed using the *in vivo* method.

153. EFFECTS OF PRAIRIE DOGS ON THE DIET OF THIRTEEN-LINED GROUND SQUIRRELS *SPERMOPHILUS TRIDECEMLINEATUS*

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In northern Colorado, thirteen-lined ground squirrels (*Spermophilus tridecemlineatus*) are more abundant in grasslands without black-tailed prairie dogs (*Cynomys ludovicianus*) than in active prairie dog colonies. The intensive habitat modifications associated with colonies may reduce the quality and abundance of food resources. I used stable carbon (C) and nitrogen (N) isotope analysis to characterize the trophic relationships among plants and animals on and off of prairie dog colonies. I hypothesized that the C stable isotopic ratios of ground squirrels would be lower, and N ratios higher, off of colonies. Tissue samples were collected from ground squirrels on active colonies and in grassland areas without prairie dogs in 2004–05. In 2010, arthropods were captured on and off colonies and plant samples were collected off colonies to represent the most abundant food items for squirrels on shortgrass steppe. There was a significant decrease in $\delta^{13}C$ value of squirrel tissues in 2005 off colony, suggesting an increase in consumption of C_3-plant derived foods. In contrast, arthropods from colonies in 2010 had significantly lower $\delta^{13}C$ values than those collected off colony, suggesting that they took advantage of C_3 forbs associated with prairie dog disturbances. Both on and off colony, $\delta^{15}N$ values increased according to trophic position, with predatory spiders and omnivorous ground squirrels having the highest $\delta^{15}N$ and herbivorous grasshoppers having the lowest. Stable isotope analysis proved to be a useful approach to characterize the trophic relationships among plants and consumers, and determine the potential effects of prairie dogs on thirteen-lined ground squirrels.

154. CHARACTERISTICS OF A MULTIPLE DRUG RESISTANT (MDR) STRAIN OF *PSEUDOMONAS SPP.* AND IDENTIFICATION OF POTENTIAL EFFLUX PUMP INHIBITORS (EPI)

Aaron Springer, Wei-Jen Lin, and Parag Vaishampayan. California Polytechnic University of California, Microbiology Department, Pomona, Ca., 91768.

Excessive use of antibiotics has applied evolutionary stress to the bacterial population, generating genes responsible for antibiotic resistance though random mutation and natural selection. Acquisition and accumulation of genes via horizontal gene transfer has led to resistance to multiple antibiotics, known as multi drug resistance (MDR). Recently, a MDR strain of *Pseudomonas sp.* strain D9 was isolated which exhibits resistance to a core group of antimicrobial agents. Preliminary sequence analysis indicates that this strain may harbor a variant of *Salmonella* genomic island 1 (SGI1). Additionally, D9 was observed to inhibit MDR *E. coli* strains known to harbor antibiotic efflux pumps. The purpose of this study was to confirm the presence and location of SGI1 within D9, characterize D9's antibiotic resistance through antibiotic minimum inhibitory concentration (MIC) testing, and to investigate the nature of inhibition that D9 exhibits upon other MDR strains of *E.coli*. Using plasmid extraction kits and gel electrophoresis, no plasmid harboring SGI1 was found within D9. *E. coli* transformation confirmed the absence of a plasmid harboring SGI1. MIC concentrations were found for 13 antibiotics from 10 antibiotic groups. Efflux pump class-specific inhibition of efflux pump harboring *E. coli* by D9 was confirmed and common chelating agents were ruled out as causative agents. Further studies are needed to confirm the presence of SGI1 within the genome of D9, to test the MIC concentrations found against a standard organism to confirm the antibiotic concentrations used were accurate, and to determine the nature of inhibition of MDR *E. coli* by D9.

155. STRUCTURE - FUNCTION ANALYSIS OF THE SERINE PROTEASE AUTOTRANSPORTERS OF ENTERIC PATHOGENIC BACTERIA

C. Stathopoulos. California State Polytechnic University, Department of Biological Sciences, Pomona, CA, 91768.

Autotransporter (AT) is a protein secretion pathway found in Gram-negative bacteria featuring a multi-domain polypeptide with a signal sequence, a passenger domain and a translocator domain. An AT subfamily named Serine Protease ATs of the *Enterobacteriaceae* (SPATEs) is characterised by the presence of a conserved serine protease motif in the passenger domain which contributes to bacterial pathogenesis. The goal of this study is to determine the importance of the passenger domain conserved residues in the SPATE proteolytic and adhesive functions using temperature-sensitive hemagglutinin (Tsh) protein as our model. To begin, mutations of twenty-one fully conserved residues in the four passenger domain conserved motifs were constructed by PCR-based site-directed mutagenesis. Seventeen mutants exhibited a wild-type secretion level; among these mutants, eight displayed reduced proteolytic activities in Tsh-specific oligopeptide and mucin cleavage assays. These eight conserved residues were analyzed by molecular graphics modeling to demonstrate their intramolecular interactions with the catalytic triad and other key residues. Additional mutations were made to confirm the above interactions in order to demonstrate their significance to the SPATE functions. Altogether our data suggest that certain conserved residues in the SPATE passenger domain are important for both the proteolytic and adhesive activities of SPATE by maintaining proper protein structure via intramolecular interactions between the protease and β helical domains. Our analysis provides a new insight into the structure-function relationship of the SPATEs and the functional roles of their conserved residues.

156. METHODS FOR TESTING THE PRESENCE OF CADMIUM IN CYSTOLITHS OF *RUELLIA TUBEROSA*

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The tropical herb, *Ruellia tuberosa* was subjected to various concentrations of cadmium to determine if it's calcium carbonate cystoliths are able to sequester heavy metals. Seeds of *R. tuberosa* were grown on standard tissue culture media for two weeks, then transferred to cadmium infused media and left to grow for an additional two weeks. Tissue culture media contained standard nutrient concentrations with the addition of 1mg/L of the cytokinin Benzyl Adenine Purine (BAP) as well as 1mg/L of the auxin Naphthalene Acetic Acid (NAA). As a control, another set of *R. tuberosa* seeds were transferred to the standard tissue culture media after two weeks of growth, instead of the cadmium media. Cystoliths were then separated from leaves by blending in absolute ethanol, then the blended solution was strained

through cheesecloth. The heavier cystoliths descended to the bottom of the collecting flask, which allowed for the removal, by pipette, of the lighter dissolved leaf solution. The captured cystoliths and dissolved leaf solutions were then sent to California State University, Long Beach for qualitative confirmation of cadmium, using Inductively Coupled Plasma Mass Spectrometry (ICP-MS).

157. A COMPARISON OF GROWTH, REPRODUCTION, AND TISSUE PRODUCTION OF TEMPERATE REEF FISHES ON ARTIFICIAL AND NATURAL REEFS

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Artificial reefs are commonly used to mitigate damage to natural reefs, yet how well these artificial reefs function is still widely debated. One major question yet to be resolved is whether artificial reefs produce fishes at rates equivalent to those on natural reefs. We tested whether rates of reef fish growth, reproduction, and total tissue production on a large artificial reef (Wheeler North Reef) were comparable to those on two nearby natural reefs. Adults from five of the most common rocky reef fishes in the Southern California Bight (California sheephead, kelp bass, barred sand bass, señorita, and blacksmith) were collected during the spawning season. Rates of growth, reproduction, and tissue production of each species were generally similar on the artificial and natural reefs, with rates on the artificial reef being most like those on the natural reef nearest to it. These generally similar rates of tissue production (somatic and reproductive) are congruent with similar foraging success (based on gut fullness) of fishes on the three reefs. The similar performance of fishes living on the artificial and natural reefs implies that well-designed artificial reefs can mitigate damage to natural reefs by enhancing production of reef fishes.

158. ENVIRONMENTAL EFFECTS ON A RATTLESNAKE STIRKE

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The strike is a significant behavior for many snakes, as it can be critical for both prey capture and defense against predators. Various factors contribute to the speed of a snake's strike, with temperature being one of them. As ectotherms, reptiles' performance during various behaviors often exhibit strong temperature dependence, particularly those for which muscle contraction rates play a critical role. Performance is maximized at a thermal optimum, below and above which performance is reduced. The protraction phase of the strike may be a ballistic action (i.e., powered by recovery of energy stored by muscles prior to the onset of the movement) versus retraction phase that is powered by direct muscle contraction. Using the genus *Crotalus* (rattlesnakes) as a model system, I plan to examine strike performance across a range of temperatures. A comparison among published single-species studies indicates that viperids (rattlesnakes and relatives) have the fastest strike among snakes with the forward moving component of the strike occurring in 0.02 seconds, which is faster than a human eye blink. I hypothesize that *Crotalus* have a ballistic component to the protraction phase of the strike, which will reduce or eliminate the effects of temperature changes. In contrast, I hypothesize that the retraction phase of the strike will be strongly temperature dependent, reflecting the effect of temperature on muscle contraction velocity.

159. MECHANICS OF PREY CAPTURE IN FROGS WITH BALLISTIC VS. NON-BALLISTIC TONGUE PROJECTION

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Terrestrial frogs capture prey using tongue projection, which can be based on either a ballistic or non-ballistic mechanism. In ballistic forms (e.g., *Bufo*), tongue projection is rapid, and the tongue can double in length. Previous work indicates that this mechanism depends on the storage and recovery of elastic strain energy in the jaw-opening muscles (depressor mandibulae [DM]) as they are activated prior to the mouth

opening. Energy recovered from the muscles then powers mouth opening, and momentum from the lower jaw is transferred to the tongue. Non-ballistic tongue projection (e.g., *Ceratophrys*) is slower, and the DM are not active prior to prey capture. In ballistic projectors, the energy storage phase requires a means to resist mouth opening prior to prey capture while the DM generate force and store energy. A potential mechanism is based on specialized jaw morphology that provides an interface for wet adhesion that produces a resisting force to mouth opening. To test the hypothesis that this mechanism is necessary for ballistic projection, but not for non-ballistic projection, we interfered with wet adhesion between the upper and lower jaws. We implanted wires into the maxillary grooves of *Bufo* and *Ceratophrys* specimens and used high-speed imaging to record feeding trials. Feeding performance was not affected in non-ballistic *Ceratophrys*, in contrast to a strong negative effect on ballistic *Bufo*. These results support a growing body of evidence that prey capture in ballistic tongue projectors requires precise synchronization of jaw and tongue neuromechanics. Non-ballistic tongue projectors, however, do not require this.

160. UTILIZING MICROCONTROLLERS TO AUTOMATE PHOTONICS LAB EXPERIMENTS

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In order to simplify and more accurately perform two procedures in the photonics laboratory, automated systems using microcontrollers interfaced with LabVIEW were developed. The LabVIEW programs were built to communicate with the microcontrollers via a USB cable. One, to control a five channel optical switch, was built with the feature of automatic and manual settings. The optical switch allowed for multiple components to remain connected, but analyzing the signal only through one at a time. The user could choose which channel the light signal would travel either through the computer or by selecting the channel manually, thus disabling the automatic feature. This was done through a series of interconnected transistors, contingent upon where the voltage was applied. A temperature controller was built to monitor and stabilize the temperature surrounding an optical fiber system. By using an array of high output current transistors, a thermoelectric element could be heated or cooled. Inverting the signal of the pulse width modulator from the microcontroller had the effect of changing the polarity of the driving circuit, which allowed for the control of the direction of current through it. Both of these systems were comprised of inexpensive components and could be implemented by any student well versed in electronics and programming. They need to be further tested in order to determine their limitations.

161. FUNCTION AND DIVERSITY IN COASTAL SAGE SCRUB: HOW RESTORED IS RESTORED

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The Puente Hills extend southeast from the San Gabriel River to the Santa Ana Mountains, and encompass roughly 40,000 acres of coastal sage scrub, walnut woodland, oak woodland, and riparian scrub. The remaining open space in the Puente Hills includes Chino Hills State Park at the southeast end of the complex, and open space owned by the City of Whittier and the Puente Hills Landfill Native Habitat Authority to the northwest. Although the Puente Hills include areas of undisturbed coastal sage scrub, there are areas that were formally coastal sage scrub which have converted to communities dominated by non-natives; this conversion is partly due to extensive planting of eucalyptus during oil extraction, and partly due to grazing and altered fire regimes. The Puente Hills Native Habitat Authority has engaged in an extensive restoration effort, in part funded by revenues from the landfill, but also providing mitigation opportunities for development elsewhere in the greater Los Angeles area. We were interested in examining the degree to which these restoration efforts are successful in establishing the diversity and function of the coastal sage scrub community. Our intitial findings suggest that individual shrubs in restored areas experience greater water stress, perhaps as a result of overplanting, or as a result of changes in root shoot allocation strategies that limit water availability during summer drought. We suggest that restoration efforts that involve extensive irrigation may result in decreased drought tolerance for shrubs which may decrease survivorship of these shrubs in a changing climate.

162. LONG TERM PROTECTION BY A LIPOSOMAL HSV-2 VACCINE (L-GD$_{1\text{-}306}$-HD/MPL) IN OUTBRED SWISS WEBSTER FEMALE MICE

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Genital Herpes Simplex Virus 2 (HSV-2) affects 1 in 5 Americans over age 12. In a previous study, 3 doses of L-gD$_{1\text{-}306}$-HD/MPL vaccine conferred significant protection in Swiss Webster female mice challenged intravaginally with HSV-2 at one week post boost. The present study was done to assess if this same dose would confer long term protection up to 8 weeks post boost. Female Swiss Webster mice (n=7/gp for survival, n=5/gp for cytokines) were immunized subcutaneously with L-gD$_{1\text{-}306}$-HD(80μg)/MPL(15μg) or L-control/MPL(15μg) d0, d28, d63. Mice were challenged intravaginally with 10LD$_{50}$ HSV-2 at 1, 4 or 8 wks post boost and monitored for morbidity and disease signs. L-gD$_{1\text{-}306}$-HD/MPL mice were significantly protected vs L-control/MPL mice following challenge at 1 week (86% vs 29% survival), 4 weeks (100% vs 0% survival) or 8 weeks (86% vs 14% survival) post boost, with significantly reduced mucosal and neurological signs in all challenges ($P<0.05$). On day 53 post boost, ELISPOT and Luminex® cytokine assays showed significantly higher numbers of gD$_{1\text{-}306}$-HD-specific IFN-g and IL-4 secreting splenocytes and significantly higher levels of secreted IFN-g (57pg/mL vs 0pg/mL) and IL-4 (33pg/mL vs 2pg/mL) in the L-gD$_{1\text{-}306}$-HD/MPL mice compared to L-control/MPL mice ($P<0.05$). NA titers at week 8 were 256 (Range: 0–2048) for L-gD$_{1\text{-}306}$-HD/MPL vs 0 for L-control/MPL ($P=0.22$). Long term protection against HSV-2, generated by L-gD$_{1\text{-}306}$-HD/MPL in female Swiss Webster mice, was associated with both a Th1 and Th2 response, indicating the presence of protective memory T cells even after two months post boost.

163. PHYLOGENETIC POSITION OF THE PIT VIPER *CRYPTELYTROPES HONSONENSIS*

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Cryptelytrops is a genus that contains 13 species of pit vipers. About 7 of these are endemic to southern Asia—India, Bangladesh, the Andaman Islands, and Indochina. DNA was extracted from two tissue samples of the newly described specie *Cryptelytrops honsonensis*. In addition to samples from several other populations of undescribed species. Samples for *Cryptelytrops honsonensis* were obtained from Hon Son island in Rach Gia Bay, Kien Giang province of southern Vietnam. Genomic DNA was extracted from the tissue samples. Mitochondrial *Cytochrome B* and *ND4* genes were amplified and then sequenced. Multiple alignments of the sequences was constructed and phylogenetic analyses using maximum likelihood (ML) and Bayesian Markov chain Monte Carlo inference (Bayesian MCMC) algorithms. Our data showed, with strong ML bootstrap support and high Bayesian posterior probabilities, that *Cryptelytrops honsensis* is a closely related sister taxon to *Cryptelytrops macrops* but farther relation with sister taxa *Crypelytrops kanburiensis* and the combined *Crypelytrops cardamomensis /venustus* the clade.

164. PHYLOGEOGRAPHIC ANALYSIS OF THE SPECIATION OF *CYRTODACTYLUS INTERMEDIUS* LIZARDS

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Cyrtodactylus is the largest gekkonid genus known to this day. Phylogenetic analysis of mitochondrial gene *CytochromeB* and *ND2* sequences, obtained from South East Asian specimens that were previously classified as *Cyrtodactylus intermedius* of the gecko genus *Cyrtodactylus* suggest that new species have emerged through allopatric speciation. These populations were isolated on limestone karsts and islands as sea level rose and the subsequent partial submerging of mountains in Cardamom chain shortly after the Pleistocene. Sequencing results from the specimens yielded a total of 331 base pairs for the *Cytochrome*B gene and 650 base pairs for the *ND2* gene. Populations representing from seven separate collection sites

had divergent sequence variations consistent with allopatric speciation. Conclusions are consistent with geographic distributions.

165. FISHWATCH - U.S. SEAFOOD FACTS

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*To say seafood is sustainable is to say that fish are being managed in a way that can provide for today's needs without damaging their ability to reproduce and maintain abundant populations for future generations.

The majority of fish and shellfish caught in federal waters off of the U.S. are harvested under fishery management plans that must meet a well defined list of national standards to ensure healthy fish stocks are maintained, overfishing is eliminated, and the long-term social-economic benefits to the nation are achieved. FishWatch is an online seafood consumer tool that communicates the most up-to-date information on marine fisheries science, conservation, and management to the public.

FishWatch gives consumers facts, the facts they need to make informed choices.

166. THE INTERACTION OF *ALLIGATOR MISSISSIPPIENSIS* AND ITS HELMINTH PARASITES

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As one of the surviving reptilian archosaurs of an ancient phylogenetic lineage, it is probable that the interaction between *Alligator mississippiensis* and its parasites has developed into a near-commensal, and possibly mutualistic association. Yet, anthropogenic and environmental factors are perturbing this interaction, increasing alligators' susceptibility to parasite virulence. This may have serious consequences because the disruption of a potentially coevolved relationship between hosts and parasites can lead to disease dispersal, host population fluctuations, and host epidemic mortality. I am studying these intestinal helminths over a three year period to assess host-parasite distribution patterns in populations of *A. mississippiensis* in Louisiana in response to environmental and anthropogenic impacts. Intestinal tracts of alligators that vary in size, gender and geographic location have been collected during the Louisiana wild alligator harvest with the assistance of Louisiana Department Fisheries and Wildlife (LDFW). To date, specimens from two harvests have been collected and analyzed. Helminth prevalence, intensity, and abundance is found to be significantly higher in alligators of Eastern Louisiana wetlands, as well as in males. Parasitism is shown to have decreased from year one to year two, indicating an external factor is affecting parasite transmission, which can have a direct effect on alligator fitness. The alteration of normal parasitic alligator fauna can result in the invasion of novel pathogens, resulting in host morbidity and/or mortality. Continued data collection and assessment will be vital for local wildlife and wetland management agencies as they deal with wetland restoration from past hurricane activity, and urbanization management.

167. ACANTHOCEPHALAN PARASITISM OF THE SOUTHWESTERN SPECKLED RATTLESNAKE, *CROTALUS MITCHELLII PYRRHUS*

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The Southwestern Speckled Rattlesnake, *Crotalus mitchellii pyrrhus,* Cope 1866 (Serpentes: Viperidae) is a medium sized crotalid species generally not exceeding 100 cm in total length that ranges from northwestern Mexico into the southwestern United States. Although the ecology of viperids in Arizona is well studied, parasitism of Arizona snake species in the family Viperidae is not well documented. We

conducted an analysis for gastro-intestinal parasites on four specimens of *C. m. pyrrhus* from southwestern Arizona. A significant discovery was the high acanthocephalan parasitemia of one particular specimen. Eighteen acanthocephalans were discovered embedded in the internal mucosa of the small intestines, as well as on the external surface of the conjunction of the small and large intestines of this female snake. Acanthocephalans were identified as from the family Paleorhynchidae. This investigation is the first to document parasitism in *C. m. pyrrhus*. Future work on the ecological impact of these acanthocephalans, as well as host-parasite dynamics within this xeric environment, should be continued.

168. STEM WATER TRANSPORT EFFICIENCY INCREASES AND CAVITATION RESISTANCE DECREASES IN POST-FIRE RESPROUTS OF CHAPARRAL SHRUBS

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In California, chaparral shrubs suffer fire-induced crown death during periodic wildfires. Chaparral shrubs reestablish in burned areas either by recruiting seedlings from a fire-cued seed bank or sprouting from a lignotuber (root crown). Among species that sprout from lignotubers, obligate sprouter (OS) species do not recruit seedlings into burned areas, whereas facultative sprouters (FS) do recruit seedlings into these areas. We investigated how the water transport system of resprouting burned plants changes in response to the dramatic shifts in plant root to shoot ratio as well as increases in water and nutrient resource availability that follow wildfire. We hypothesized that resprouting plants would exhibit increased water transport efficiency but decreased stress resistance compared to unburned plants. This would allow resprouting plants to exploit post-fire resource pulses. Further, we hypothesized this shift would be greater in OS than FS species. Eight months after fire, resprout stems of four OS and four FS species generally had greater transport efficiency and were more vulnerable to water stress-induced xylem cavitation than stems of unburned plants. These differences between stems of resprouts and unburned plants may result from differing xylem structure. Although resprouts had lower stem cavitation resistance, these differences did not necessarily equate to greater embolism during the dry season because predawn and midday water potentials remained higher in resprouts relative to unburned plants. The reduced water stress resistance of resprouts is a potential mechanism by which fire and drought may interact to alter chaparral community regeneration.

169. THE GROWING PROBLEM OF ANTIBIOTIC RESISTANCE: NEW INSIGHTS IN THE SEARCH FOR A SOLUTION

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Multiple-drug resistance is emerging at an alarming rate in the hospital environment as well as in the community. The seriousness of the problem is best illustrated by the recently released World Health Organization report, where it is clearly stated that in the absence of corrective action the world is rapidly heading towards the pre-antibiotic era. As a consequence, there is an urgent need to develop new antibiotics and strategies to preserve the activity of existing ones. Our laboratory contributes to these efforts with its program to develop antisense compounds that inhibit expression of enzymes that mediate antibiotic resistance. We use as model system the aminoglycoside modifying enzyme AAC(6′)-Ib, which mediates resistance to amikacin and other aminoglycosides. Inhibition of expression of the gene coding for this enzyme will extend the useful life of clinically important aminoglycosides. We have shown that recombinant plasmids coding for adequate short antisense oligoribonucleotides elicit RNase P-mediated cleavage of the target mRNA inducing inhibition of expression of *aac(6′)-Ib* and a decrease in amikacin resistance. However, since oligoribonucleotides are very unstable, development of a viable RNase P-based antisense technology requires the utilization of nuclease-resistant analogs. Our analysis of a wide variety of analogs showed that selected Locked Nucleic Acids/DNA co-oligomers elicited RNase P-mediated cleavage of mRNA in vitro and induced phenotypic conversion to susceptibility to amikacin of the hyperpermeable *E. coli* AS19 strain harboring *aac(6′)-Ib*.

170. FACTORS AFFECTING COURTSHIP SUCCESS AND BEHAVIOR OF A TEMPERATE REEF FISH, *BRACHYISTIUS FRENATUS*

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Size can play an important role in determining reproductive success through the establishment of dominance hierarchies and female selection. I explored the relationship between size of individuals and courtship success in the kelp perch, *Brachyistius frenatus* in the field off the coast of Southern California at Catalina Island. Courtship displays were timed and the length of the interaction was used as a measure of success. In addition, I observed how individuals of this species spent their time performing different activities throughout the day and in two adjacent algae dominated habitats. I found that size played a significant role in determining the success of courtship, and that the time allocated to different activities of individuals varied significantly with time and habitat, and less so with gender and the size of males. As opposed to large size alone, size ratio appeared to be the most important factor in determining the mating system of *B. frenatus*, where males were most successful courting females of comparable size and females preferred large males.

171. A NEW VISION FOR THE SAN GABRIEL MOUNTAINS

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The San Gabriel Mountains are an irreplaceable natural resource that gives Los Angeles County 70% of its open space, provides 35% of the region's drinking water, and contributes clean air to a polluted region. The forest serves as critical habitat for many endangered and sensitive plant and animal species including the Nelson's Bighorn sheep, California condor and the spotted owl. The San Gabriel Mountains Forever Campaign along with local residents and communities are working to protect this magnificent mountain range's wild places by seeking strong federal protections for public lands: A **National Recreation Area**, **Wilderness** and **Wild and Scenic River** designations.

172. CONSIDERATIONS FOR THE EXPLORATION OF THE INTERNAL OCEAN OF EUROPA

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Plans are now under way for several missions to the Jupiter moon Europa by several space programs, particularly NASA and the European Space Agency. At a conference at the Space Research Institute of the Russian Academy of Sciences in Moscow in February of 2009 discussion about missions to Europa were the main topic. In considering a hydrobot to explore the internal ocean of Europa, several important considerations must be made. The hydrobot has to be a small vehicle able to fit a small payload on a Europa lander. The vehicle will probably be a cryobot/hydrobot combination which will be in the form of a penetrator. The penetrator will have a heat generating drill on its nose to get through a thin layer of water ice and when the penetrator enters the internal ocean it will deploy fins and glide horizontally through the upper water column of the internal ocean. The hydrobot may only reach subsurface ice layers which have formed with the refreezing of the Europa crust. Geological features on Europa such as lineae, chaos and lenticulae imply that warm ice diapirs in the internal ocean have melted the Europa crust repeatedly after Rossby waves form in the internal ocean.

173. WAS THERE AN INTERNAL OCEAN IN THE LARGE ASTEROID VESTA AND ASTROBIOLOGICAL ORIGINS FROM PROTO/DWARF PLANET CRATERING IN THE ASTEROID BELT

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The large asteroid Vesta is a differentiated asteroid with a metallic core, olivine mantle and crust. Vesta was a dwarf planet similar to the dwarf planet Ceres which is also in the same region of the asteroid belt. Like Ceres, Vesta may have had an internal ocean at one time as a dwarf planet. Impact debris with ice

from Vesta along with other proto/dwarf planet cratering histories in the asteroid belt (e.g. the large asteroid Pallas) may contain microbes and may provide astrobiological material to the inner solar system. It is also possible that this astrobiological material can reach the Jupiter system.The asteroid Vesta will be imaged by the orbiting NASA DAWN spacecraft in 2011 and 2012.

174. EFFECT OF HUMAN PROSTHETIC METAL COMPOSITION ON RECEPTOR ACTIVATOR FOR NUCLEAR FACTOR KB (RANK) AND RANK LIGAND (RANKL) EXPRESSION, LEADING TO OSTEOCLAST ACTIVATION

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The U.S. has seen an increase in the number of artificial joint replacements (knees, hips, shoulders) needed among our growing and aging population. In general, prosthetics last approximately 15 years before needing to be replaced. This occurrence happens mainly due to the bone erosion around the metal, resulting in prosthetic loosening. Metal implants activate immune cells, which cause osteoclasts to become over-activated. The osteoclast cells resorb the bone faster than osteoblasts can replace.

The primary receptor on osteoclast precursors (macrophages), Receptor Activator for the Nuclear Factor kB (RANK), and its ligand on osteoclast activators (fibroblasts and osteoblasts), RANKL, interact and result in differentiation of the precursors into mature osteoclasts. However, it is unknown whether osteoclast precursors or osteoclast activators up-regulate their receptors in the presence of newly developed implant biometals. To test this, each cell type was cultured on various biometals, including stainless steel (SS), commercially pure titanium (CPTi), Ti-6Al-4V, and novel titanium alloys containing varying levels of boron. After 48 to 72 hours of interaction, the expression levels of precursor RANK and activator RANKL were analyzed by immunostaining and flow cytometry. Preliminary results demonstrate that traditional stainless steel induces both RANK and RANKL on osteoclast precursors and osteoblasts, respectively, more than CPTi and Ti64. This suggests that titanium may induce lower osteoclast activation through lower RANK and RANKL induction, hence contributing to prosthetic longevity. We are currently testing whether boron incorporation into titanium alloys has any effect on RANK or RANKL expression levels, thus providing an advantage over traditionally used biometals

175. RAPID RADIATION OF NORTHEASTERN PACIFIC *DENDRONOTUS* (MOLLUSCA: OPISTHOBRANCHIA) INFERRED FROM NUCLEAR AND MITOCHONDRIAL GENE DATA

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The Indo-Pacific tropics contain the largest diversity of opisthobranch sea slugs as well as of many other marine invertebrates. In opisthobranch clades including tropical and temperate species, most of the species diversity is in the Indo-Pacific region. One of the few exceptions is *Dendronotus*, which has more species in the northeastern Pacific than in any other region of the world.

This paper attempts to test hypotheses for this unusual pattern, using nuclear and mitochondrial gene data to infer the phylogeny of *Dendronotus* and the rates of divergence across this group. With the available data it appears that continuous closures and openings of the Bearing Strait might have been influential in the rapid diversification in the northeastern Pacific *Dendronotus* species.

176. ATOMIC FORCE MICROSCOPE INVESTIGATIONS OF BACTERIAL BIOFILMS TREATED WITH GAS DISCHARGE PLASMAS

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We present investigations of bacterial biofilms before and after treatment from gas discharge plasmas. Gas discharge plasmas represent a way to inactivate bacteria under conditions where conventional disinfection methods are often ineffective. These conditions involve bacteria in biofilm communities, where

cooperative interactions between cells make organisms less susceptible to standard killing methods. Previously, we studied the biofilm forming bacterium *Chromobacterium violaceum*, and showed from atomic force microscope (AFM) images that bacterial cells undergo sequential morphological changes during plasma treatment. In the present work, we used an AFM to study the biofilms formed by the common bacterium *Pseudomonas aeruginosa*. Biofilm structure was investigated through AFM images for plasma treatments lasting from 5 to 30 minutes. In addition, micromechanical properties of the biofilms were studied through force versus distance curves by pressing the AFM tip into the biofilm surface while monitoring the cantilever deflection. Reductions in biofilm thickness and biofilm adhesion were measured following plasma treatment. The results indicate that biofilm structure and stability, in addition to cell morphology, are significantly impacted by the plasma treatment.

177. GLUTATHIONE ENHANCES T CELL RESPONSES AGAINST MYCOBACTERIUM TUBERCULOSIS INFECTION

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Individuals infected with human immune deficiency virus (HIV) are known to be susceptible to *M. tuberculosis (M. tb)* infections. The ability of glutathione (GSH) to augment the activity of natural killer (NK) cells in the control of *M. tb* infection as indicated by our previous studies lead us to hypothesize that GSH will also augment the activity of T-cells in the control of *M. tb* infection. Further we believe that the decreased intracellular *M. tb* growth will be accompanied by increased production of TH1 cytokines that are essential for the control of intracellular pathogens. Our results indicate that treatment of T cells from healthy individuals with a GSH precursor, N-acetyl cysteine (NAC) directly leads to the increased production of the TH1 cytokines IL-2, IL-12, and IFN-γ. These cytokines drive the TH1 response and are crucially important in the immune response to intracellular pathogens like *M. tb*. This is the first study to demonstrate that treatment with NAC results in the increased activity of human T-cells, and control of *M. tb* infection *in vitro*. Furthermore, our results show that patients infected with HIV have significantly lower levels of GSH within their T cells in comparison to healthy subjects. This decrease in GSH concentration is correlated with decreased TH1 cytokine levels in plasma when compared to healthy individuals. Our data indicates the possibility of efficacy for supplemental GSH therapy in *M. tb* and HIV infected patients.

178. FISHERIES OBSERVERS: COLLECTING FISHERIES DEPENDENT DATA ON THE WATER

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Fisheries Observers are biologists who ride along on commercial fishing vessels during fishing trips. Each year, more than 40 different US fisheries are monitored by observer programs, logging over 60,000 observer days at sea. Since 1972, NOAA Fisheries has relied heavily on data collected by observers, such as species identification, fishing effort (eg. Number of hooks or nets deployed), fish size, interactions of protected species, etc.. Observers have monitored fishing activities on all US coasts, collecting data for a range of conservation and management issues. Observers are deployed on trips ranging from day to 30 days or more. Fisheries Observers can collect on-the-water data that cannot be gathered through other sources such as logbooks or landings tickets. Observers play an important role in the management of sustainable fisheries by gathering firsthand data on catch as well as bycatch and discards. The data collected by the observer programs are often the best means to get current data on the status of many fisheries. Without observers and observer programs, there would not be sufficient data in many fisheries for effective management. The observer provides reliable data on catch location, gear configuration, and bycatch reduction measures. Observers can also conduct biological sampling on a wide variety of species, which further benefits management efforts by providing information on species' genetics and stock structure, growth rates and seasonality of species movements, all of which feed into management models to maintain sustainable fisheries.

179. DOES THE INTRODUCED RED ALGA *CAULACANTHUS USTULATUS* (GIGARTINALES, RHODOPHYTA) AFFECT UPPER ROCKY INTERTIDAL COMMUNITIES IN SOUTHERN CALIFORNIA WATERS?

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Although introduced species of seaweeds are established in coastal habitats worldwide, the ecological effects of only an estimated 6% (17 of 277) of seaweed introductions have been studied. The turf-forming red alga *Caulacanthus ustulatus* (Turner) Kützing, native to warm temperate coasts of SE Asia, was first observed in southern California in 1999, yet has received very little attention despite being common at most rocky intertidal sites in the region. Although found occasionally throughout the mid-intertidal zone, it is common in the upper zone and can cover up to ~23% of available habitat based on our surveys. The purpose of this study was to evaluate the potential affects of *C. ustulatus* on native upper-intertidal invertebrate and seaweed communities. Comparisons of macro- and meiofaunal community structure, seaweed diversity and sediment accumulation in plots with or without *C. ustulatus* in the upper-intertidal zone were conducted at three sites in Orange County and two sites in Los Angeles County. Significant differences in macro- and meiofaunal assemblages existed between patches of *C. ustulatus* and neighboring areas that lacked the introduced seaweed. Additionally, significantly more seaweed species were found in areas where *C. ustulatus* was present. The dissimilarity in the upper-intertidal invertebrate and algal communities in areas with *C. ustulatus* was likely attributed to the new habitat it provided, as well as the increased sediment that accumulated (up to ~125 cm^3 m^{-2}) within it.

180. DIETARY COMPOSITION INFLUENCE ON FOOD INTAKE, WEIGHT GAIN, MEAL PATTERN AND SEXUALLY DIFFERENTIATED CANNABINOID-INDUCED HYPERPHAGIC RESPONSES IN MALE AND FEMALE GUINEA PIGS

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We investigated the impact that dietary composition had on cannabinoid-induced changes in feeding behavior demonstrated by adult gonadectomized male and female guinea pigs. These animals were fed either a standard grain-based diet or a blend of this diet with a specially formulated high-fat Westernized diet in a 1:1 ratio. While consuming either diet, the animals were treated daily for seven days with the cannabinoid receptor agonist WIN 55,212-2 (0.1 mg/kg; S.C.) or its Cremephor /ethanol/ saline vehicle (1ml/kg; S.C.). We measured incremental and collective food intake, as well as meal frequency, meal size, meal duration and body weight on a 24-hour basis over the seven-day period. Inherently, when the high-fat Westernized diet was introduced to male and female participants, they exhibited a comparatively greater cumulative daily consumption and weight gain than those eating the standard diet. The previous effect was supported when referencing the incremental hourly intake. Further analysis of meal pattern unveils that females displayed longer meal duration, and that the high-fat diet increased meal duration more abundantly in females than in their male counterparts. However, they ate meals at a contrastingly lesser frequency, while the high-fat diet decreased meal frequency even more. This produced a high-fat diet induced upsurge in meal size that was more substantial in females than observed in males. Interestingly, the gender difference in the cannabinoid-induced increased appetite response - with males demonstrating a comparatively greater intake of the grain-based diet –was reversed in animals fed the high-fat diet. Compiling this information, these results suggest that dietary composition can influence food intake, weight gain, meal pattern, and sexually differentiated cannabinoid-induced hyperphagic responses in male and female guinea pigs.

181. INVESTIGATING HYBRIDIZATION IN TWO SOUTHERN CALIFORNIA APLYSIIDS

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Aplysia californica and *Aplysia vaccaria* co-occur in southern California waters, although *A. californica* is often intertidal and *A. vaccaria* subtidal. Reports exist that the two species might hybridize (Painter et al, 2004). The present research project seeks to confirm these observations with a combination of genetic analyses and laboratory behavioral observations. Ten specimens of each species and ten egg masses were collected and their DNA was extracted. The mitochondrial gene CO1 and the nuclear gene H3 were amplified and sequenced in order to characterize these two species genetically. The research also seeks to observe and confirm these mating behaviors in a controlled laboratory environment. *Aplysia californica* is widely used as a model species for biomedical and neurological research; thus, understanding the biology of this species has broad implications for other fields of science. *Aplysia vaccaria* is unique among aplysiids for its loss of ink-releasing capabilities. The confirmation of hybridization between these species will constitute the first such observation among opisthobranch mollusks.

Painter, S.D., S.F. Cummins, A.E. Nichols, et al. 2004. Structural and functional analysis of Aplysia attractins, a family of water-borne protein pheromones with interspecific attractiveness. PNAS 101 (18) 6929-6933

182. HERMIT CRABS (*COENOBITA CLYPEATUS*) HAVE PERSONALITY

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Individuals may vary in consistent ways and when we find such variation in nonhumans, we refer to this as personality. There is a large and rapidly growing literature documenting personality in vertebrates and a number of studies have identified consistent individual differences in invertebrates. We aimed to study personality in terrestrial hermit crabs, specifically whether and how traits were consistent across different behavioral contexts. We conducted an *inversion test* (Briffa et al., 2008), where each subject was inverted and we timed the latency to emerge; an *open field test*, where each subject was placed in the center of an arena and we quantified the latency to emerge and movement; and a *simulated predator attack test* (Chan et al., 2010) where a video of a hawk appeared to swoop down on the crab and we measured the latency to respond. Each subject was tested multiple times in each context so we could quantify its individual plasticity for each trait. There was significant inter-individual variation in each context suggesting that crabs respond to these situations consistently. Furthermore, there were correlations across contexts suggesting the crabs had a behavioral syndrome that broadly integrates how they respond to alarming situations. This was most notable in the latency to emerge from the inversion and open field tests, although it was not restricted to these tests. Thus, terrestrial hermit crabs, like many other species, have personality. This work is a first step towards addressing the remaining fundamental questions about the factors that maintain personality variation.

183. RESOURCE STRUCTURE AND DIET BREADTH AT LATE PALEOINDIAN SITES DURING PLEISTOCENE-HOLOCENE TRANSITION: A VIEW FROM THE GREAT PLAINS AND SOUTHEAST

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The archaeological record of Paleoindians has strongly favored the discovery of large game kill sites with projectile points. Recent data has helped archaeologists to develop a framework to test new models about the use of biotic and abiotic resource structure during the Pleistocene-Holocene transition. This generalized strategy reflects regional diversity in the subsistence economy of Paleoindian foragers. Data are presented for numerous sites types such as rockshelters, caves and camp sites from the Great Plains and the Southeast to test further theoretical models about the broad spectrum foraging hypothesis. Information from faunal, botanical, site structure, and transport of lithic material are examined to determine if hunter-gatherers were altering their resource structure based on microenvironments during the Pleistocene-Holocene transition.

184. CULTURAL OR NATURAL DEPOSITION: AVIAN REMAINS AT CAVE OF THE CHIMNEYS, SAN MIGUEL ISLAND

Emily Whistler. CSU Los Angeles.

This poster presents taphonomic studies of aves remains from Cave of the Chimneys (CA-SMI-603), a coastal rockshelter on San Miguel Island that spans 6,000 years of human occupation. Specimens are identified to the lowest possible taxa and quantified using MNI, NISP, and dry weight measurements. Charring of bird bones, tool making debris, breakage patterns, and other modifications indicate purposeful use by humans. Ethnographic accounts further confirm cultural ties with certain avian species. Lack of modifications on bones of small species suggests they were likely prey items of owls or other raptors. Distinguishing between naturally and culturally deposited aves remains contributes to our understanding of depositional processes and occupation/abandonment cycles.

185. RESPONSE OF BENTHIC FOOD WEBS TO CHANGING FLUSHING REGIMES IN A SOUTHERN CALIFORNIA LAGOON

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When southern Californian lagoons close for extended periods, *Ruppia maritima* (widgeongrass) thrives in the resultant lower salinity, higher temperature water. Because plant cover is a main source of spatial heterogeneity in Pacific coast wetlands, such changes in plant community can influence the abundance, diversity, and food web structure of invertebrates. Our objective was to describe the role of *R. maritima* in structuring the benthic community and food webs in San Dieguito Lagoon.

Multivariate analysis indicates differences in fauna composition between subtidal areas with and without *Ruppia* as well as between intertidal and subtidal areas. We conducted natural abundance stable isotopic analyses to describe the food web and isotopic enrichment experiments to create an unambiguous marker that could track *Ruppia* through the food chain. For our isotopic enrichment, we transplanted lagoon *Ruppia* plants to the laboratory, injected the sediments with 12 mmol/L ammonium sulfate and allowed them to grow for a 7-day period. Once the plants accumulated sufficient label, we redeployed *Ruppia* as detritus in mesh bags into a randomly paired block design in both subtidal and intertidal habitats. Results of natural abundance and enrichment experiments indicate that N derived from labeled *Ruppia* detritus is entering the sediment food web, particularly as a portion of the diet of shredders such as *Monocorophium* spp. and deposit feeders such as *Capitella* sp. complex. Understanding the benthic community alterations due to changes in plant cover and in flushing regime will increase knowledge of complex wetland interactions and aid conservation of Southern California lagoon ecosystems.

186. EFFECTS OF ARTIFICIAL MOONLIGHT ON THE FORAGING BEHAVIOR OF MOJAVE DESERT RODENTS

Bryan White and Paul Stapp. CSU Fullerton.

Desert rodent communities are extremely diverse, which has prompted researchers to ask how so many species can coexist on similar, limited resources. Differences in foraging preferences associated with predator avoidance may contribute to coexistence. I determined how the foraging behavior of Mojave Desert rodents, especially pocket mice (*Chaetodipus*), were influenced by the increase in perceived predation risk associated with moonlight, which I simulated using artificial illumination. Millet (6.00 g) was mixed into trays filled with 2 L of pre-sifted sand. Seed trays were placed at stations located at different distances (2–82 m) from Coleman camping lanterns, and in either open or shrub microhabitats, so that rodents could choose to forage from resource patches with different levels of perceived risk. I also live-trapped rodents to identify likely foragers near the lanterns, and to determine the diversity and abundance of rodents in the area. Background illumination levels were recorded with using a Lux meter. I predicted that the amount of seeds removed would be highest at seed trays farthest from lanterns and under shrubs, and lowest at stations closest to lanterns and in open microhabitats. Surprisingly, I found no effect of distance, microhabitat, or illumination level on the amount of seeds removed by rodents.

187. INPUT AND EXTRACTION: USING INDICES OF BENTHIC COVER, ALGAL AND INVERTEBRATE DENSITY, AND INDICATOR SPECIES TO DETERMINE ANTHROPOGENIC INFLUENCES ON ROCKY REEFS

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Following World War II, a population boom along the southern California coast directly resulted in increased anthropogenic influences on the Pacific Ocean. Increased residential, commercial, industrial, and infrastructure needs, as well as increased commercial and recreational extractive activities impacted rocky reefs throughout the Southern California Bight. Anthropogenically influenced trophic cascades with regards to extractive activities and urchin/kelp interactions have been well studied. However, the extent of urchin barrens on rocky reefs in southern California has been difficult to determine given the lack of a quantitative definition of an urchin barren. We present an index derived from urchin density, macroalgae density, and benthic cover that quantifies the spatial scale and severity of urchin barrens along the southern California coast. In addition, the effects of wastewater disposal, storm drains, and recent anthropogenically-triggered landslides have prevented photosynthetic activity due to turbidity, scoured rocky reefs clear of all biotic benthic cover and even buried entire reefs in sediment. We present an index of abiotic and sediment-tolerant benthic cover on rocky reefs that provides information on the location and severity of sediment-impacted reefs. Together, these two indices can provide important insight for ecosystem-based management, guide decisions on management of individually impacted species, and aid rocky reef restoration efforts throughout the Southern California Bight.

188. NOVEL APPROACHES TO DATA-POOR FISHERIES MANAGEMENT

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Conventional fisheries stock assessment models were designed for industrial-scale offshore stocks and require substantial time series of catch and effort data. However, a majority of the world's fisheries are small-scale, possess limited data (i.e. data-poor), demonstrate geographic variation in harvest pressure, and target species with spatially variable demographic rates. Novel management strategies that overcome data limitations and match the spatial scale of ecological dynamics with the spatial scale of management are needed. No-take Marine Protected Areas (MPAs) present an opportunity to measure natural mortality, fishing mortality, relative depletion, and other useful management metrics at local scales. Integrating such information into novel management strategies can improve decision-making and meet sustainability criteria for data-poor fisheries. Collaborative fisheries research involving fishermen, scientists and managers generates social capital in the community and can be a cost-effective means to gather data for MPA-based, data-poor fisheries management strategies. Here, I describe a collaborative fisheries research program in the northern Channel Islands designed to collect length frequency, CPUE, and biological data for grass rockfish (*Sebastes rastrelliger*) inside and outside of a network of MPAs. I use these data in simulation studies to demonstrate the conservation and yield benefits of novel, MPA-based, data-poor management strategies.

189. REGENERATION OF OAK WOODLANDS IN SOUTHERN CALIFORNIA: A COMMUNITY EFFORT

Mark von Wodtke. FASLA, Professor Emeritus of Landscape Architecture, and Ronald D. Quinn, Ph.D., Professor Emeritus of Biological Sciences and Regenerative Studies, California State Polytechnic University, Pomona, CA, 91768.

The goal of the ACORN project is to regenerate oak woodlands. This provides a less fire-prone interface between urbanization and wild lands. Such woodlands enhance watershed, and airshed, while conserving and restoring Southern California biodiversity.

We are working in the Claremont Wilderness Park which is in the foothills of the San Gabriel Mountains. In the lower park canyons, coast live oaks (*Quercus agrifolia*) were reduced by settlers seeking firewood and building materials.

The ACORN project began with landscape architectural graduate students at Cal Poly Pomona.

Community groups such as Boy Scouts, Girl Scouts, local school ecology groups, and Uncommon Good, have been gathering acorns each fall, which are then propagated and planted during the next winter. The Chapman Forestry Foundation has been providing funding for this community effort. We have used these funds to pay Rancho Santa Ana Botanic Garden for the nursery propagation, to hire some labor to help with the planting, and for the past 3 years, to pay student research assistants to monitor planting results.

Not surprisingly, the survivorship of planted oaks is low, and varies from year to year. The best indicator of favorable planting sites is the presence of mature oaks. Sprouted acorns are a viable way to plant with less effort (and cost) and the results are comparable to planting year-old seedlings grown in containers. Infrequent summer irrigation improves survivorship of seedlings. We have planted companion species, such as Toyon (*Hetereomeles arbutifolia*) to attract scrub jays (*Aphelocoma californica*), natural agents for regenerating oak woodlands.

190. OPTIMIZING THE GAUSSIAN MASK ALGORITHM

Nahom Yirga. Alex Small California State Polytechnic University, Pomona CA.

The Gaussian Mask Algorithm is commonly used to locate the actual position of fluorophore after it has been imaged by the CCD array. It is fast, but its an iterative algorithm that involves the evaluation of a transcedental thus it takes a good amount of processing time. To simplify the algorithm we expanded the PSF in a taylor series about the center of the image. This simplification reduces the number of transcedental calculations to just one per pixel and allows us to achieve speed without a significant compromise in accuracy. The information lost from the reduction of the algorithm can be analyzed by expanding the original image via a set of orthogonal basis images and reducing the image by ignoring noise prone high spatial frequencies. The reduced image was then analyzed by the original algorithm and it can be clearly seen that the accuracy of the information extracted from the image is exactly identical to the information that is obtained from the reduced algorithm.

191. RESTORATION & WATERSHED PRACTICES FOR URBAN/WILDLANDS INTERFACES: SAN GABRIEL MOUNTAINS

T. Young, R. Montijo, and **A. Croissant**. San Gabriel Mountains Regional Conservancy (SGMRC), P.O. Box 963, Glendora, CA 91741.

"When envisioning habitat restoration and preservation, few people imagine the intense grid of the San Gabriel Valley. Indeed, even most lifelong residents of the Valley are at a loss to describe any natural features in the valley at all, much less any worth preserving or enhancing.

And yet, numerous natural areas, some quite large, defy the choking constraints of intense urbanization and thrive here. A number of these areas still boast greater biodiversity than many pristine habitats in other less developed locations in the nation." *Reconnecting the San Gabriel Valley*, June 2000

First of regional watershed studies since the 1930s and first of the new millennium, *Reconnecting* (2000) has left a legacy over the past decade of best management practices and nationally recognized successes in land management, biodiversity rescue, and natural resource protection within the San Gabriel River Watershed.

Continuing evidences of *Reconnecting* include: watershed doctoral research, best management practices, large scale fuel modification projects, linear buffer park designs, endangered species management, land acquisition/stewardship management, WOW Conferences/invasives control, conservation makeovers, nonprofit conservancies recruitment. *Reconnecting* successfully incorporates connectivity, sustainability,

and regenerative practices. Newer projects focus on water conservation practices, insect ecology and vector control in biodiversity, climate change/natural disaster reconnaissance with policy implications.

SGMRC/ *Reconnecting* received recognition from County and State APA (2000); National SSI (2007); Regional ICC Environmental Leadership (2009).

www.sgmrc.org

192. BIOCHEMICAL INVESTIGATION INTO THE PRESENCE OF THE GOLGI APPARATUS IN SPIDER SILK GLANDS

R. Zafra[1] and M.L. Casem[2]. [1]California State University, Fullerton, Department of Chemistry and Biochemistry and, [2]Department of Biological Science, Fullerton, CA 92831

The Golgi apparatus in eukaryotic cells is responsible for processing and sorting of secretory proteins. Spider silk is composed of proteins that are synthesized on the rough endoplasmic reticulum (rER) and secreted from cells into the lumen of silk-producing glands. Silk proteins should be processed through the Golgi as they move from the rER to the lumen of the silk gland, however, the Golgi is not apparent in transmission electron micrographs of silk-producing cells. I have conducted a biochemical assay for the presence of the Golgi in tissues of the black widow spider, *Latrodectus hesperus,* using a glycoprotein western detection kit. I will combine glycoprotein detection with an assay for EndoH sensitivity to determine whether these glycoproteins have been modified by the Golgi apparatus; causing them to become EndoH resistant. If I find EndoH sensitive glycoproteins in silk glands it would suggest that an alternate secretory pathway may exist in spiders.

193. *PSEUDOMONAS AERUGINOSA* BIOFILM INACTIVATION BY GAS DISCHARGE PLASMA

Zelaya A.[1], Vandervoort K.[2], and Brelles-Mariño G[1]. [1]Biological Sciences Department; [2]Physics Department. California State Polytechnic University, Pomona, USA.

Biofilms are microbial communities embedded in an exopolysaccharidic matrix and responsible for undesirable effects including disease and prosthetic device contamination. Biofilms are more resilient to standard killing methods than free-living bacteria. Therefore, there is a need to develop novel sterilization techniques and the use of gas discharge plasmas represents an alternative method.

We are presently studying plasma-mediated inactivation of *Pseudomonas aeruginosa* biofilms grown on different surfaces such as polycarbonate, stainless-steel, and borosilicate for 1, 3, or 7 days. These biofilms were treated with an atmospheric pressure plasma jet. After removing free cells, biofilms were exposed to plasma for various exposure times, scrapped off the coupons, and processed to determine CFUs/mL. For atomic force microscopy (AFM), coupons were rinsed twice and air-dried. Images were collected in air in intermittent contact mode.

Results indicate almost 100% of cell removal after a 5-minute plasma treatment. The inactivation kinetics is similar for 1, 3, and 7 day-old biofilms and shows a rapid decline in the number of surviving cells followed by a much slower decline. No differences were observed for the 3 materials used. AFM was used to image biofilms and to study micromechanical properties through force versus distance curves. The stiffness, adhesiveness, and biofilm height change after treatment suggesting that the architecture and the stability of the biofilm may be impacted by plasma treatment.

These results show the potential for plasma as an alternative sterilization method against biofilms.

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194. MGO COMPOSITE PAINTS: PROTECTING HUMANS AGAINST HARMFUL BACTERIA

David Zuniga, Jeanaye Mason, Daniel E. Murrieta, and Cal Poly Pomona. Mentors: Winny Dong, Tanya Faltens, Chemicals & Materials Engineering, Cal Poly Pomona.

Traditional magnesium oxide (MgO) is an ionic crystalline solid with high bactericidal effectiveness. Other forms of MgO, amorphous MgO xerogels and aerogels can be synthesized via the sol-gel process. These novel structures are highly porous, giving them a greater surface area and concentration of

structural defects than crystalline MgO. Increasing these two factors is expected to increase the bactericidal effectiveness of MgO. In this work, we investigated the synthesis and properties of paints containing MgO xerogels and aerogels, which are of interest for aerospace and household applications. We have found that MgO reacts with water-based paint, causing it to prematurely solidify. To avoid this solidification, we investigated two anti-drying agents including glycerin and methanol. We found that addition of 45–53wt% of glycerin to a paint of composition (list the wt% of each component in our paint) is effective in preventing solidification of the paint.X-ray diffraction (XRD) analysis of the MgO paint composite indicates that MgO reacts with water in the paint to yield magnesium hydroxide (Mg(OH)2). In previous work, finely ground MgO powder suspended in aqueous solution was shown to maintain bactericidal effectiveness. In these previous studies, possible structural changes resulting from MgO reacting with water were not investigated. Future work will focus on evaluating the bactericidal effectiveness of different magnesium oxides and hydroxides, the kinetics of the MgO reaction with water, and the incorporation of MgO into acrylic or oil based paints.

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The BULLETIN is published three times each year (April, August, and December) and includes articles in English in any field of science with **an emphasis on the southern California area**. Manuscripts submitted for publication should contain results of original research, embrace sound principles of scientific investigation, and present data in a clear and concise manner. The current AIBS *Style Manual for Biological Journals* is recommended as a guide for contributors. Consult also recent issues of the BULLETIN. Manuscript preparation guidelines are at SCASBULLETIN.ORG.

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Holmes, T. Jr., and S. Speak.1971.Reproductive biology of Myotis lucifugus. J. Mamm., 54:452–458.

Brattstrom, B. H.1969.The Condor in California. Pp. 369–382 in Vertebrates of California. (S. E. Payne, ed.), Univ. California Press, xii+635 pp.

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Cover: Adult *Acanthemblemaria balanorum* in shelter at Las Animas in the central Gulf of California, Mexico. Photo by J. Lund, reproduced by permission.